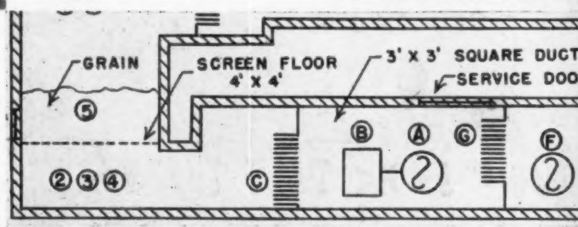
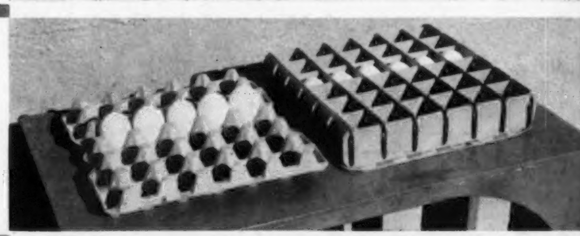
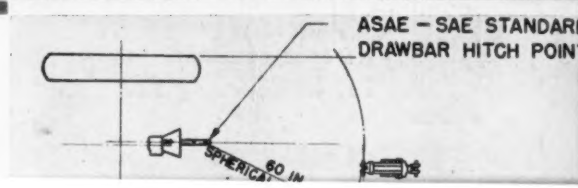
AUGUST 1957

Agricultural Engineering

The Journal of the American Society of Agricultural Engineers







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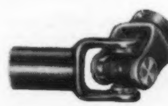

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Agricultural Engineering

Established 1920

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JAMES BASSELMAN, *Editor and Publisher*

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International Drainage Report

THE American Society of Agricultural Engineers was represented at the sixth International Congress of Soil Science in Paris, August 28 to September 8, 1956, by C. H. van Bavel, ARS, USDA, North Carolina Agricultural Experiment Station. He submitted the following report on a discussion of international cooperation in drainage research:

The idea of constituting a representative group which would organize a program and make definite proposals at the Special Session of Commission 6 at Vienna in August, was introduced by a delegate from Holland. The services of the International Institute for Land Reclamation and Improvement for the coordinating and secretarial duties were offered.

Mr. Van den Berg of Holland spoke in favor of keeping drainage research in the area of Commission 6 of the International Soil Science Society rather than letting it drift away into the engineering area.

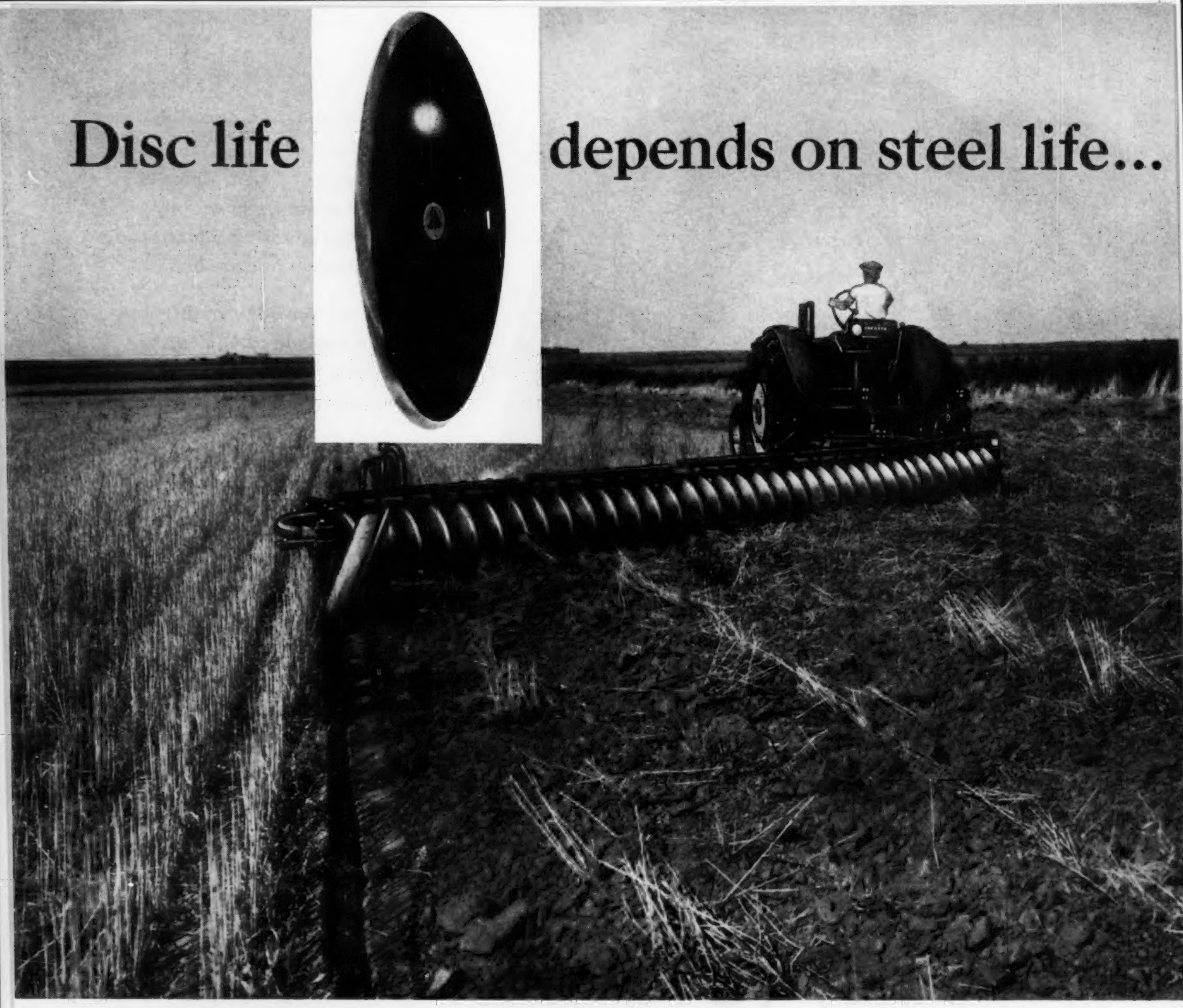
The fact that there already exists an International Commission for Drainage and Irrigation, was brought out by a United States representative. (This Commission met in May, 1957, in San Francisco at which time agronomic and soils aspects as well as engineering problems were presented.) The importance of avoiding duplication was pointed out, however, it was decided that there would probably be no duplication between the two meetings since they were scheduled so far apart and for different type audiences. It was felt that any active group promoting international cooperation in drainage research should encompass both organizations. (In the meantime the meeting for Vienna has been canceled, plans are now being made for 1958.)

Several other comments led to the decision to organize an international work group, first on an informal basis. This group is to include representatives of the International Commission on Irrigation and Drainage and the Commission 6 of the International Soil Science Society.

Although little was accomplished in the way of selecting any work objects for international cooperation, a beginning was made. It was apparent that it was too soon for any technical discussions and the group was too large and too unfamiliar with the situation to have a meeting of minds. The delegates of the various countries seemed to be convinced of the desirability of a cooperative effort and indicated that they would contribute actively, once clear objectives could be formulated.

Sprinkler Irrigation Data Sheets

COPIES of a data sheet developed by the ASAE Sprinkler Irrigation Research Committee in cooperation with the Sprinkler Irrigation Association, U.S. Farm Home Administration and U.S. Soil Conservation Service (reprint of pages 141-144, 1957 AGRICULTURAL ENGINEERS YEARBOOK) are available from ASAE Headquarters. The purpose of the data sheet is to meet the needs of the field engineer for a data form on which all pertinent information for the design of a sprinkler irrigation system would be recorded and kept as a permanent record. It could be used also as a standardized form for submitting bids for sales of such systems. Individual copies are 30 cents. Quantity prices are $13.40 for first 100 copies; $1.90 for each additional 100 copies. Send order with remittance to ASAE, 420 Main Street, St. Joseph, Michigan.



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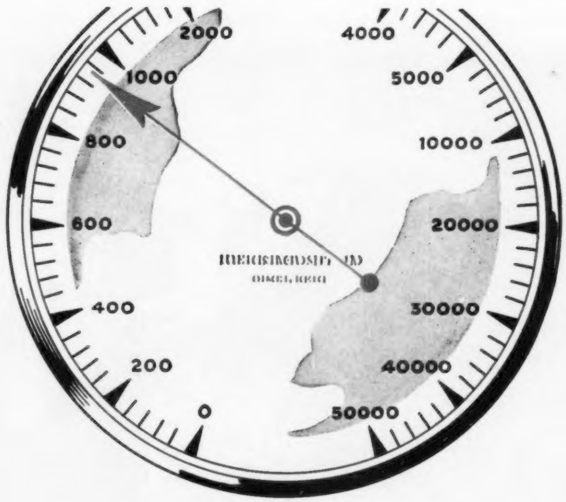

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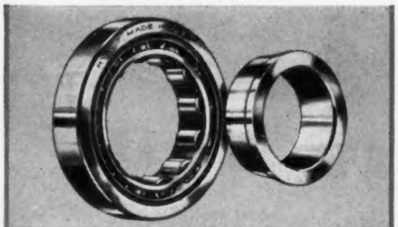

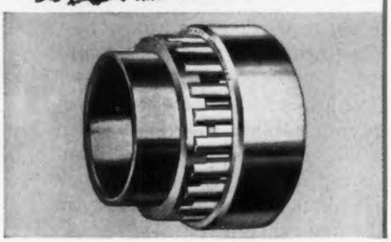

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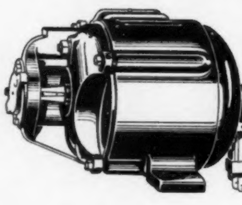

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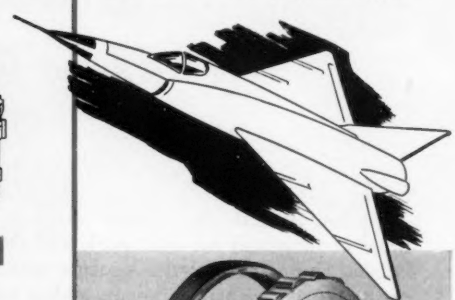

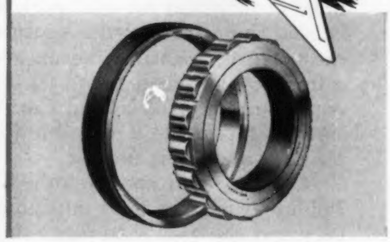

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Report to Readers . . .

BEARING PERFORMANCE STUDIES POINT WAY TO INCREASING CAPACITY RATINGS For over 30 years one of the leading manufacturers (Timken) of anti-friction bearings, used widely in farm machinery, has conducted more than 6,000 laboratory studies of bearing performance, by the use of fatigue-life machines. These studies have produced a three-fold result: (1) the experience and data gathered have made possible more accurate prediction of bearing life; (2) a review of life in the field of millions of bearings provided vital information on which to base increased capacity ratings, and (3) refinements in the method of analyzing these studies mathematically made it possible to increase bearing capacities. . . . The company has increased most capacity ratings by approximately 10 percent, some by as much as 39 percent. This will mean smaller bearings in many applications, resulting in a more compact product and use of less material, since the size of shafts and housings can be reduced. . . . The machine designer will see in all this an opportunity to reduce manufacturing costs. The ultimate beneficiary will of course be the farmer.

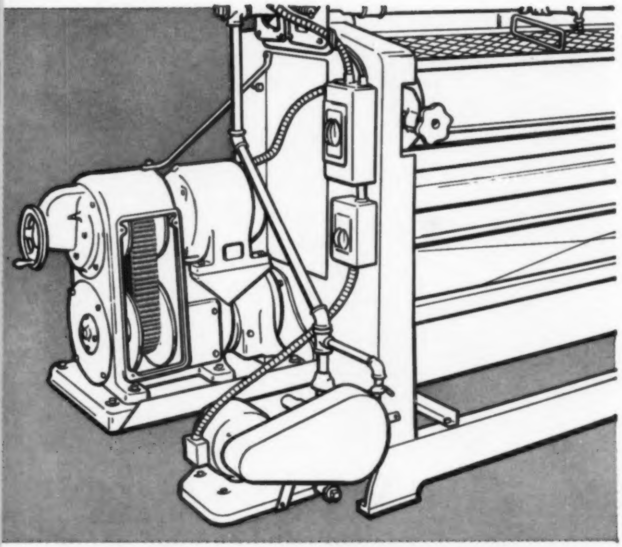
BRITISH EDITOR COMMENTS ON HAY PELLETING ADVANTAGES The following pat editorial observation on hay pelleting is from "Farm Implement and Machinery Review" of London: "The mechanization of handling and feeding hay . . . would be made easier by changing hay from a fibrous mass to a free-flowing material similar to grain. Hay has been the most difficult part of the stock ration to feed mechanically. Chopping assists, but does not solve the problem. Pellets are readily handled with any standard conveyor, and can be moved in and out of storage mechanically, and by gravity. Storage space is reduced, in addition to which better payloads are possible in haulage, with easier loading and unloading. As to animals eating the pellets, studies to date indicate that poor quality pelleted hay may show nearly twice the gain obtained with the same hay fed chopped or baled, although optimum gains with pellets have been obtained with top-quality material."

A GEM OF A SALUTE TO THE A.S.A.E. That's the way we felt about one of the many excellent tributes or salutes to the American Society of Agricultural Engineers on the occasion of the Society's Golden Anniversary this year. This salute is in the form of a two-page spread in IHC's "Harvester World" for June. It reads: "On Nature's large canvas, the American farm of 1957 looks to be a copy of its counterpart of 1900. But don't be fooled. Tranquility hasn't been tampered with, but profound changes have affected farming and farmers; a 'technological explosion' has been touched off. The men who operate the slide rules for agriculture have given to the man of the soil a new measure of efficiency, while eliminating most of his drudgeries. Today's farmer plants better seeds in better fields with better machines and gets vastly greater yields. With help from the engineers, he curbs the erosion of his topsoil, feeds his cattle by pushing buttons, produces an acre of wheat with 1.82 man-hours of labor (as against 57.7 before mechanization). For these and other advances, he and all Americans are indebted to a dedicated band of men. International Harvester salutes the nation's professional agricultural engineering organization, the A.S.A.E., on the occasion of its Golden Anniversary."

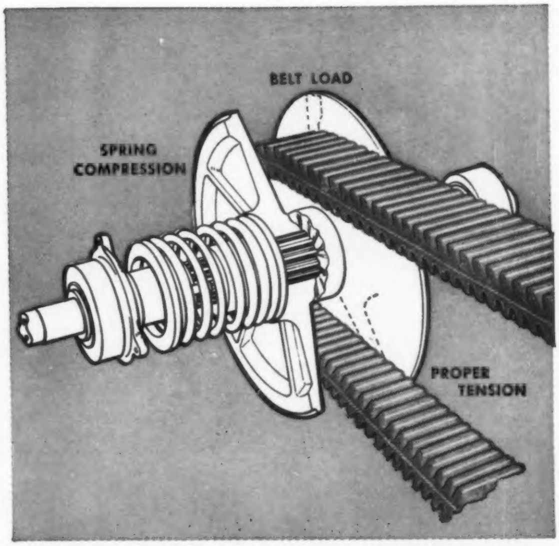
A PROMISING STEP TOWARD UNITY IN THE ENGINEERING PROFESSION Since the close of World War I, individuals and organizations have given much thought to achieving greater cohesion among organized groups of engineers. Many have visualized an over-all association to parallel AMA and ABA, but especially to engineers who have been more active in their professional societies, such a comprehensive organization now seems only remotely possible, if at all. . . . But what about the apparently increasing ground swell of opinion favoring faster progress toward unity NOW? A definite stirring to action in official circles of some engineering societies is taking place – and it is obvious, moreover, that the atmosphere favorable to achieving a larger measure of unity has vastly improved. . . . What presently appears to be the most logical and feasible first step toward the desired goal is the three-pronged organizational setup (technological, educational, and professional) proposed by AIEE, as follows: (1) Engineers Joint Council (EJC), to provide the medium for coordination and cooperation on technological matters; (2) Engineers Council for Professional Development (ECPD), to provide the medium for guidance in all engineering educational matters, and (3) National Society for Professional Engineers (NSPE), to provide the medium for the general promotion of the professional aspects of engineering as related to the public, including enhancement of the economic status of engineers. . . . So it would seem that now would be a good time for all engineers to come to the aid of their profession and let their ideas on this matter of unity be known to officers of their respective societies.

BIO-ENGINEERING – NEW FIELD FOR ENGINEERS At Cornell University, students may now specialize in "bio-engineering," or engineering as applied to the processing and production of biological materials. These include vitamins, antibiotics, vaccines, and many foods. . . . The courses of instruction being offered have to do with processing heat-sensitive and expensive biological materials, fermentation engineering, and the techniques of large-scale production of bacteria and molds. The courses also prepare students for work in branches of the food industry that require considerable processing, such as soluble coffee, cake mixes, and peanut butter. . . . As engineering utilized by a particular industry – and one somewhat akin to agriculture – "bio-engineering" might be thought of as a second cousin of "agricultural engineering."

AGRICULTURAL ENGINEERS AS "ARCHITECTS OF ABUNDANCE" By this term agricultural engineers are saluted and paid a glowing tribute in an attractively illustrated two-page spread in the May-June issue of "Ethyl News," published by the Ethyl Corporation, in recognition of the Golden Anniversary of the founding of the American Society of Agricultural Engineers. In this tribute the agricultural engineer is also referred to as a "dynamic partner" of the several groups of scientific specialists serving agriculture, whose work so largely involves a great variety of engineering applications. Indeed, the building of a better, more abundant, more profitable agriculture involves some engineering at almost every turn. To a very large degree, engineering is the catalyst that is essential in implementing the results of research by agricultural scientists and making these results practically available at the farm. . . . . This is what is meant by the term "dynamic partner" as used in the Ethyl salute. It further justifies the designation of agricultural engineers as "architects of abundance."



Vertical variable speed motor on this automatic Glue Spreader receives full, non-slip power from Dayton Variable Speed Cog-Belts. Exclusive double Cog design offers instant speed changes, assures maintenance of constant speeds for all operations.



Tremendous crosswise rigidity is provided by Dayton Double Cog-Belts to maintain precise speed control. Greater surface area rapidly dissipates heat of flexing, prevents heat build-up. Light weight reduces centrifugal forces and internal stresses.

Dayton's experience in building special V-Belts extends into every major field of V-Belt drive design.

In agriculture, heavy duty variable speed drives are used as traction drives on self-propelled farm implements. In addition, Dayton has designed and built special V-Belts, which successfully cope with such problems as misalignment, lack of tension adjustment, sub-diameter pulleys, backside idlers and use as a clutch.

In railway, V-Belts for under car drives for lighting, heating and air conditioning, are required to meet a whole new set of conditions, among them being extremes of weather, misalignment and continuous service. Dayton developed the first V-Belt drive for caboose electrification, which involved taking power off one side of a Cog-Belt and transmitting it from the other. Exclusive design of the Dayton Cog-Belt has been found so suitable for power transmission on the auxiliary drives of Diesel locomotives that they are installed as original equipment on over 90% of all new Diesels.

In household appliances, Dayton has delved deeply into the problems of designing and producing FHP V-Belts which will give long, efficient service with almost no maintenance. High on the list of problems are lack of space for take up, sub-diameter pulleys and elimination of vibration. These problems are simple enough to solve in pilot V-Belts, but Dayton has a successful record of maintaining pilot quality in production quantities.

In industry, conditions which require special belts vary from the space and weight limitations of machine tool manufacturers, to the "full surge" loads which hit a set of V-Belts when peak power is applied instantaneously. For general industrial use Dayton produces a standard line of V-Belts which can accommodate over a *quarter million* different drive designs.

For the answer to your drive problem, whatever it is, contact the V-Belt manufacturer who supplies 76% of the toughest V-Belt drive market in the world — The Dayton Rubber Co., Agricultural O.E.M. Div., Dayton 1, Ohio.

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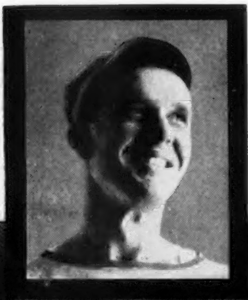
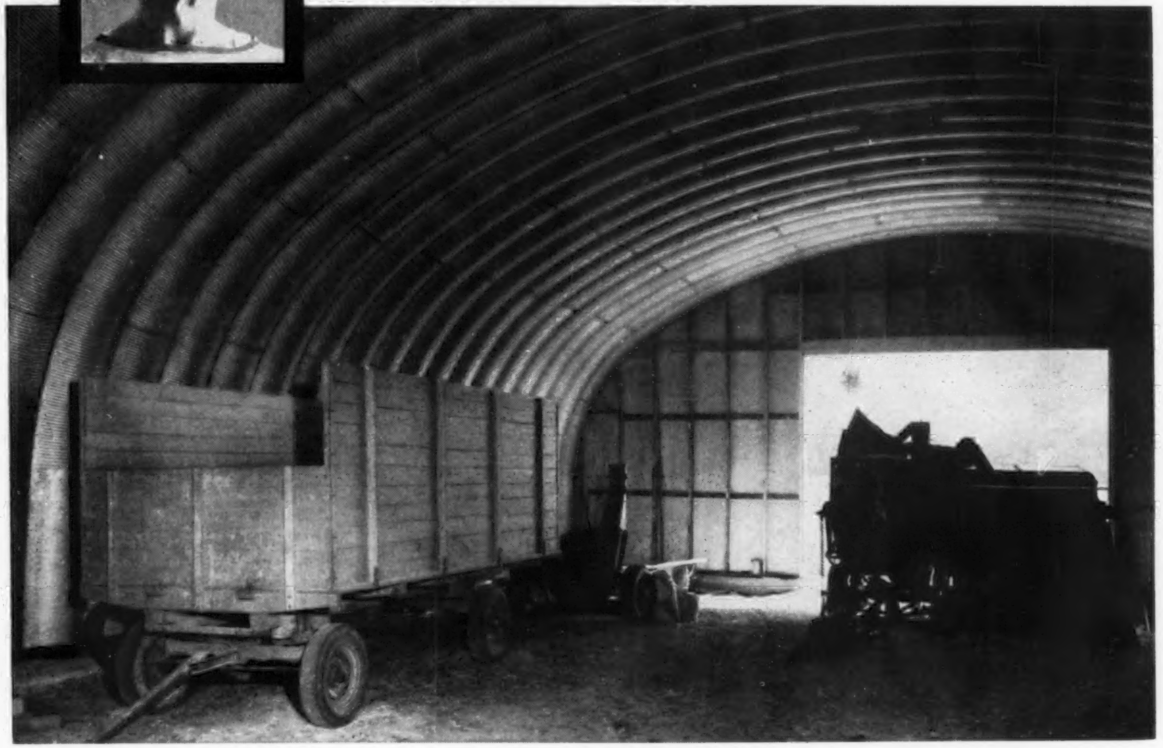


"I'm no carpenter, but I put up this steel building easily,"

says L. S. Dausman, Saranac, RD#1, Michigan



Mr. Dausman did a good job of erecting his steel building—despite the fact that he is not a skilled carpenter or builder.

In addition to the quick, easy construction of steel farm buildings, Mr. Dausman points out that he especially likes the "no maintenance" and fire-resistant features. "I lost part of my old barn by fire, but this building's not going to burn.

"Another thing," adds Mr. Dausman, "I've got more room in my steel building, with no obstructions. And, there's no problem with steel construction if I want to add on to it. It will be easy."

Mr. Dausman presently uses his steel building for equipment storage. His 220-acre farm also boasts a steel corn crib and a steel grain bin.

Factory-Built Steel Buildings, fabricated from USS Galvanized Steel Sheets, can do a great deal toward making *your* farm a more practical, better paying investment. For the complete rundown on all the advantages of Factory-Built Steel Buildings, return the attached coupon. There's no obligation, of course.

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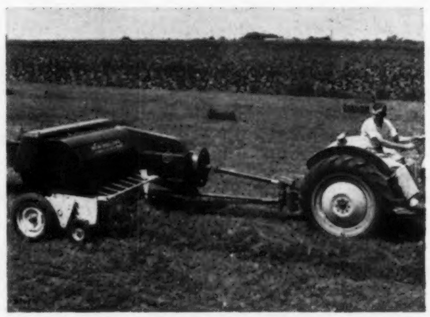
New Holland Model 800 Forage Harvester chops up grass, sorghum, or corn at a rate of up to 45 tons an hour.

New Holland Model 440 Mower Crusher cuts and conditions hay for faster curing in one trip around the field.



New Holland "Hayliner" 68 Baler is built to do any baling job on the family farm.

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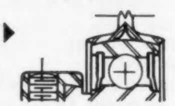
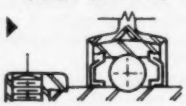
Fafnir's effective solutions to bearing problems have helped many leading manufacturers modernize the design and performance of farm implements. Chances are, the right solution to your bearing problem is available at Fafnir. Write The Fafnir Bearing Company, New Britain, Connecticut.

Fafnir Flangettes — "Economy Packages" for Farm Equipment

Extended Inner Ring and contact-type Plya-Seals in this Flangette provide ample shaft support and positive protection against contaminants. It is prelubricated at the factory . . . grease is permanently sealed in. Designed for light duty.



Mechani-Seals, slinger-type, and Wide Inner Ring construction provide a combination of frictionless operation, extra-rigid shaft support, and effective seal in this versatile Flangette. It is prelubricated, and equipped with Fafnir-originated self-locking collar.



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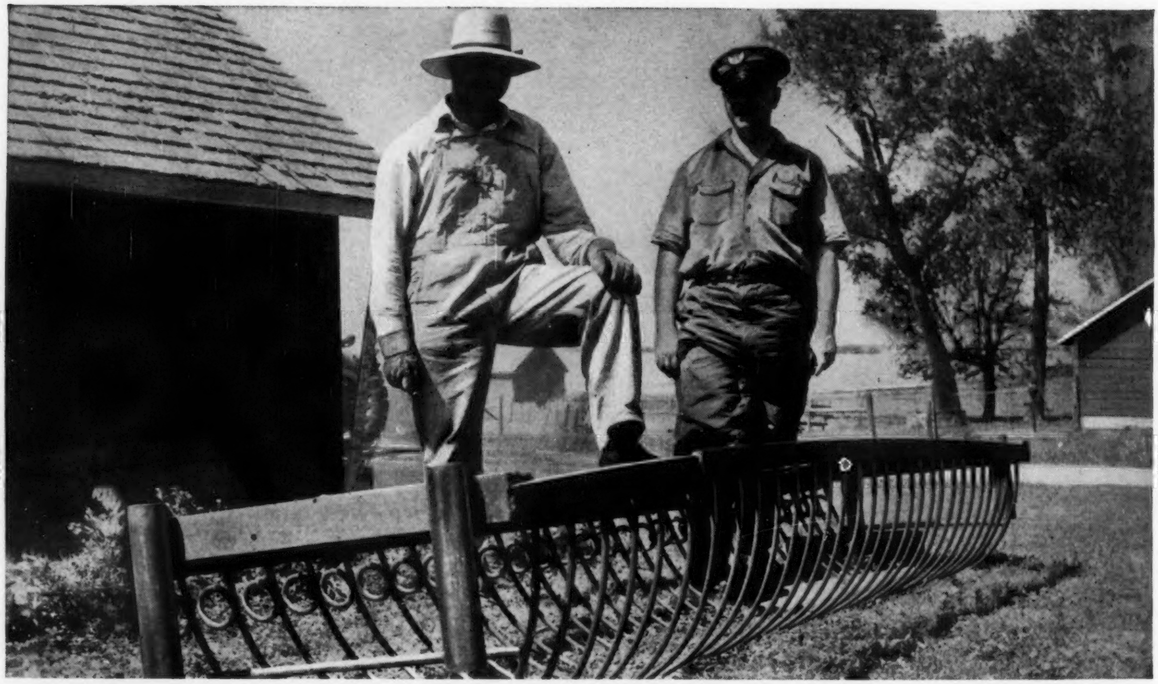

Old rake makes handy feed rack

This hay rack for outdoor feeding is the invention of Robert Glass, shown with Texaco Distributor Sam Hyland. It is constructed from an old dump rake, welded to four pipe lengths which fit over posts to keep rack off ground.

Mr. Glass raises feed for 140 head of cattle and 250 pigs on his 207-acre farm near Carroll, Iowa.

Distributor Hyland makes regular deliveries of Marfak and other Texaco products to farmers who find Marfak lubricant superior because it won't drip out, wash out, dry out or cake up — protects bearings that must take a brutal beating in field operations. Progressive farmers everywhere know *it pays to farm with Texaco products.*

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NEIGHBORLY, DEPENDABLE delivery of Texaco products is made to L. L. Lacina, Iowa City, Iowa, by Wm. "Bill" Kron, driver for the Jones-Herriott Oil Co. Mr. Lacina agrees that Advanced Custom-Made Havoline Motor Oil gives added power, longer engine life, greater gasoline mileage. No other oil can match it, regardless of price.

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Because both types of ALUMINIZED STEEL are made by coating steel with aluminum by a continuous hot-dip method, they combine the strength of steel base with the surface properties of aluminum.

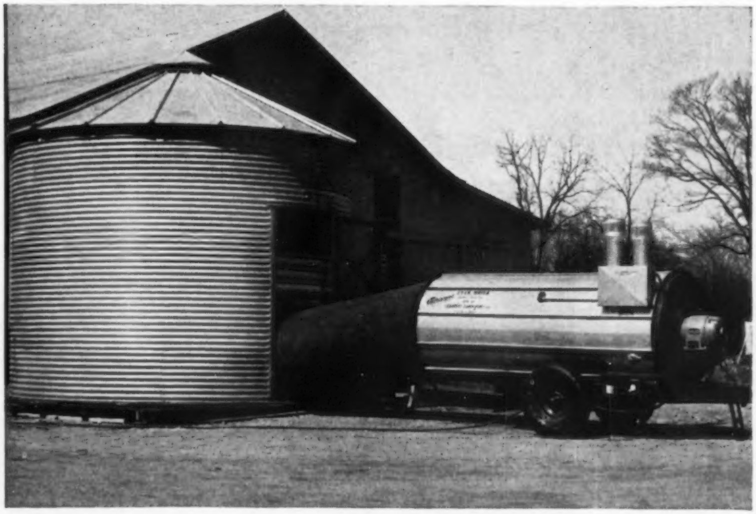
Heat-Corrosion Resistance

ALUMINIZED STEEL Type 1 has excellent resistance to a combination of heat and corrosion. When used for burners, burner tubes, and heat transfer parts, it withstands temperatures up to 1250 F with no destructive heat scaling. For reflective parts exposed to temperatures below 900 F, either type of ALUMINIZED STEEL bounces back approximately 80% of the radiant heat thrown against it.

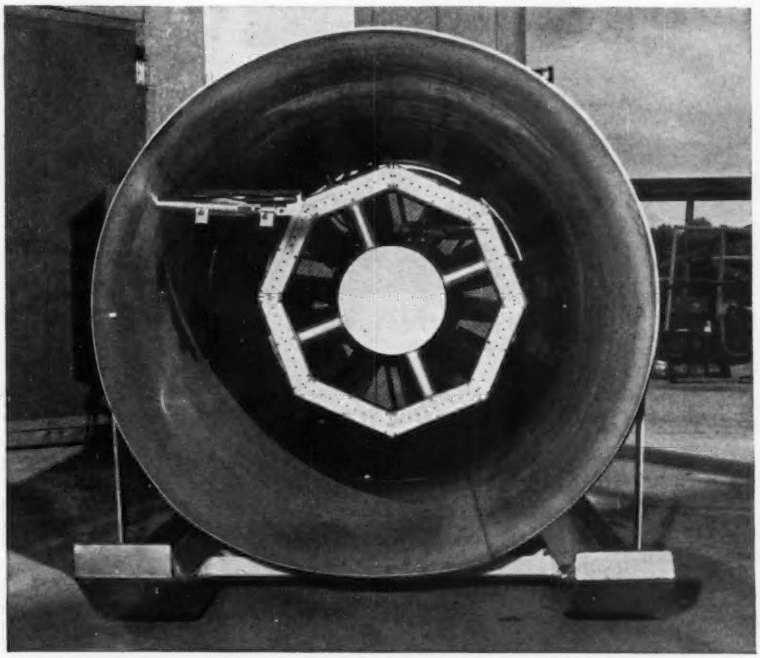
Atmospheric Corrosion Resistance

Eighteen year tests in a mild industrial atmosphere show the aluminum coating on ALUMINIZED STEEL Type 2 outlasts a standard zinc coating on steel at least three to one. Used for crop dryer casings, this special Armco Steel needs no painting or other protection from corrosion.

For complete information on the outstanding characteristics of ALUMINIZED STEEL, write us at the address below. Please tell us what you make or plan to design.



Unpainted casing and control box of Armco ALUMINIZED STEEL Type 2 can be expected to give long service. Type 1 is used inside the dryer.



Burner and burner tubes in this dryer are Armco ALUMINIZED STEEL Type 1; the casing is Type 2.

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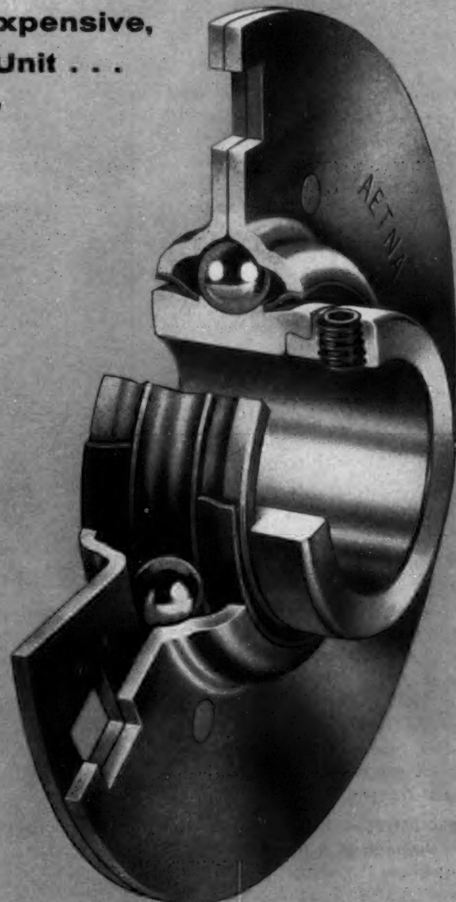
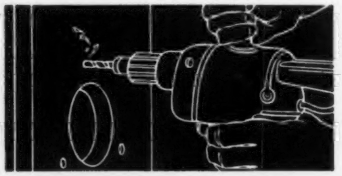


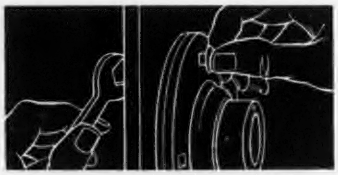
IT'S AS SIMPLE AS THIS:

A



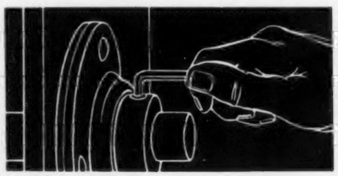
Drill (or punch) 3 bolt holes in shaft supporting member.

B



Place Adapter unit in position, insert bolts and tighten nuts.

C



Install shaft, twist locking collar, tighten set screws.

And there you have it—

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Agricultural Engineering

James Basselman, *Editor*

August, 1957
Volume 38
Number 8

Creative Engineering: What Is It?

F. H. Buelow
Assoc. Member ASAE

TERMS such as "creative thinking", "creative engineering", and "imagineering" have appeared frequently in advertisements and news stories. Many articles and books have been written about what they are, how they can be used, and how their value can be increased. Sociologists have studied the lives of people who are considered creative thinkers and from the studies tried to determine what factors make great creative thinkers. New courses in creativity are taught every year. At the present time about 500 courses deal with the subject or some particular phase of it.

The success of the creative approach in fields of science, art, management, and sales, to mention only a few, indicates that it can also be used by agricultural engineers for the solution of their problems.

But actually, what is creative engineering? It is simply the application of creative thinking techniques to the solution of engineering problems. Creative thinking, in turn, is an action of the mind which results in the production of more and better ideas. It is not daydreaming, in that effort is required for creative thinking. Creative thinking includes the ability to see the problems that surround a person. One cannot solve a problem until he recognizes it and is able to see what the problem *really* is. Creative thinking is at a higher level when the individual recognizes the problem himself than when someone presents it to him.

Another phase of creative thinking is the production of ideas for the solution of a problem. During this phase of creative thinking the mind is foreseeing, originating, inventing, completing, and revising possible solutions to a problem. The mind must be largely uninhibited by the influence of the thinking of others, emotional blocks, and lack of self-confidence. There must not be a tendency to discard ideas before they have been evaluated properly. Every new idea, no matter what its apparent value, may seem daring and subject to criticism when first conceived. But the best idea should be selected only after all ideas have been set down, and each one has been evaluated carefully. The creative thinker tends to separate the idea-forming phase and the idea-evaluation phase because ideas flow more freely and rapidly when the element of criticism and judgment are not present.

The process of creative thinking is not a pleasant one. Considerable inner drive and a feeling of dissatisfaction until the job is done are required in creative work. The frustrations, discouragements, anxieties, and hard work often required for successful completion of a creative task make many persons abandon the problem before it is completed, or never start it. Therefore a drive must be present. The unpleasant feelings usually disappear completely when the problem is completed successfully.

For a creative thinker to produce the most effective ideas in his field of endeavor requires a fundamental knowledge in the field and the ability to recall facts, combine them, and alter them to suit the problem at hand. In agricultural engineering the basic knowledge for problem solution must include the basic principles of mathematics, physics, engineering, and the natural sciences. Creative thinking thus includes the ability to see new combinations of these known principles for the solution of problems at hand.

Creative thinking is not peculiar to scientists, but is the process that is also used by artists, businessmen, architects, the clergy, medical men, and writers to perform their best work. The only difference between the professions is the background information, or "tools", with which each works. Actually, every person of sound mind has done creative thinking. Creative thinking has been done whenever a problem is encountered, possible solutions are formulated, solutions are evaluated, and the best is selected and put into effect.

Why has creative engineering suddenly become so important? One reason is that psychologists and creative engineers have studied the process of creativity and have formulated suggestions for improving one's creative abilities. The suggestions have been successfully used and as a result a greater emphasis is placed on the development of creative abilities. Creative engineering is also important because it is the source of many ideas, and a quantity of ideas usually includes some ideas with quality. Since problems are more numerous than the present number of creative engineers can solve, efforts are being made to improve the creative abilities of engineers. A person who has good creative ability is able to make the fullest use of his knowledge and experience. Everyone, and especially the engineer, is more aware than ever before that he must "engineer for tomorrow", and the fulfillment of this need requires high creative abilities.

Creative engineering in agriculture is important to make the research, teaching, extension, sales, and management phases more productive. The best thinking available must be given the farmer to help him reduce costs, make his products more valuable, reduce labor per unit output, and provide a market for all his products. The very fact that such problems exist indicates that more and a higher degree of creative engineering is necessary.

This article prepared expressly for AGRICULTURAL ENGINEERING has been selected as an editorial because of its timeliness and importance to the field of agricultural engineering.

The author, F. H. BUELOW, is assistant professor of agricultural engineering, Michigan State University, East Lansing, Michigan.

Evaluation of Shredded Legume-Grass Silage

A. M. Cowan,
Assoc. Member ASAE

K. K. Barnes, and
Member ASAE

R. S. Allen

Silage made by the flail-type forage harvester is compared with that made by conventional type machines to determine quality variations

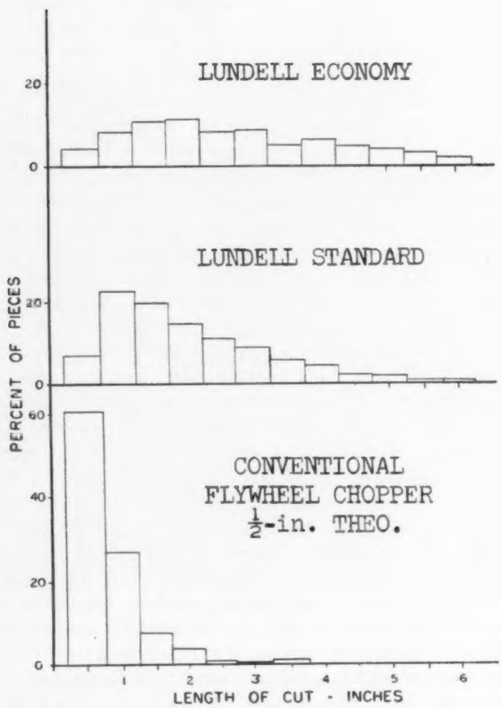

Fig. 1 *(Above)* Histogram showing frequency distribution of stem length by number of pieces of alfalfa cut with three machines

RECENTLY several low-cost, direct-cut forage harvesters have become available in the farm equipment trade. Power requirements and distribution of one of these, the flail-type, have been reported by Bockhop and Barnes (1)*. This article deals with the functional performance of the flail-type forage harvester with particular emphasis on the quality of silage made from forage cut with this type of machine. The major difference in silage made by various machines is the condition of the chopped material. Silage made by the flail-type machine suffers considerable surface damage or laceration as contrasted to the product from a conventional flywheel or reel-type of cutter head which produces a material cleanly cut. The term grass silage as used herein refers to silage made from meadow crops, including grasses and legumes.

Research in Europe (2) has indicated that silage made from material which has been severely bruised and lacerated may have some advantages. This opinion is based on the

*Numbers in parentheses refer to the appended references.

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The authors, A. M. Cowan and K. K. Barnes are, respectively, graduate assistant and professor of agricultural engineering, Iowa Agricultural Experiment Station. R. S. Allen is associate professor of chemistry and animal husbandry, Iowa State College.

Acknowledgment: The authors express their appreciation to The Lundell Mfg. Co., John Deere Ottumwa Works, and The New Holland Machine Co. for machines and assistance provided for this study.

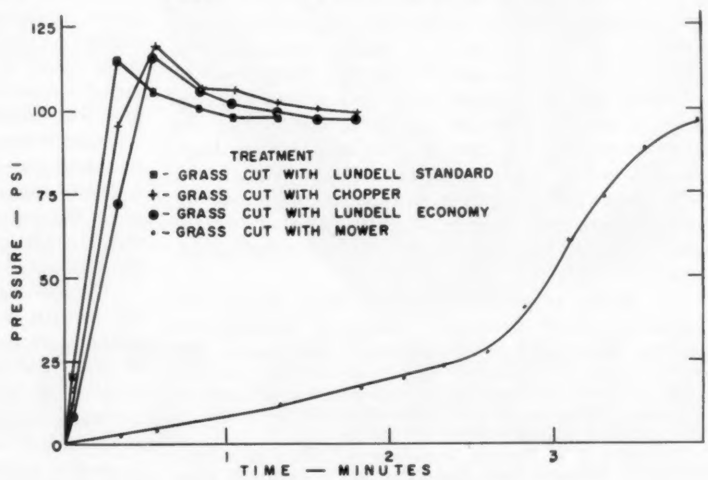


Fig. 2 *(Right)* Pressure rise in surface damage indicator showing differences in rate of reaction of calcium carbide with moisture on alfalfa cut with several machines

Fig. 3 Lundell Economy

Fig. 4 Conventional Chopper

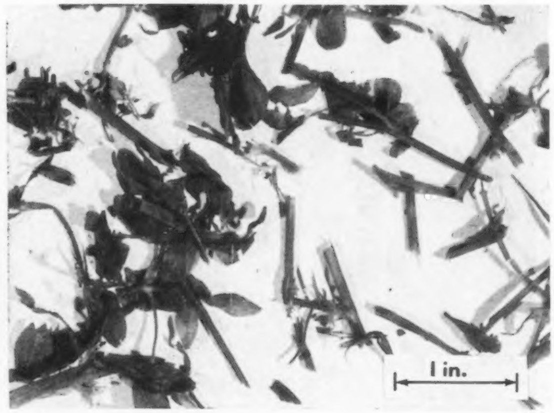


Fig. 5 Lundell Standard

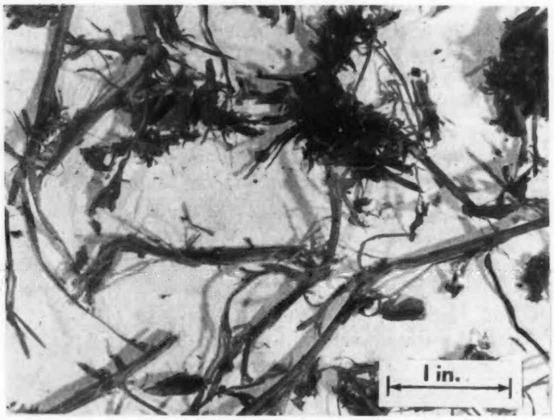


Fig. 6 Mower

Figs. 3, 4, 5 and 6 Variations in silage condition are indicated in illustrations above. In each case silage was made from green alfalfa cut standing

fact that when the plant is lacerated, part of the juices are released. These free juices provide the medium for a rapid bacterial growth and aid in compaction of the forage. The bacterial growth causes acids to be formed and silage reaches an early preserved condition of low pH.

There are many variables in the ensiling process. In order to evaluate the functional performance of a machine it is necessary to see how it fits in with the whole system and what effect it has on other variables in the process.

Purpose of the Study

This study was undertaken to accomplish the following objectives:

(a) To describe the physical characteristics of shredded grass

(b) To compare silage made from shredded grass with that made from conventionally chopped grass under field conditions

(c) To compare shredded and chopped grass silage under laboratory conditions

(d) To evaluate laboratory techniques for study of silage

Description of Physical Qualities

Several differences are observed almost immediately when a comparison is made of shredded and chopped grass. These are: length of cut, moisture or juices on the surface, and texture of the material. In order to arrive at a description of shredded grass produced by a flail-type forage harvester, these differences were measured in a quantitative manner.

Length of cut. The Lundell standard and economy model forage harvesters and a conventional flywheel-type chopper were used for a comparison of length of cut. Descriptions of the Lundell standard and economy machines are given by Bockhop and Barnes (1). Samples were taken from alfalfa cut by each of the three different machines. The pieces of grass in each sample were measured and counted. From these data frequency distribution histograms were drawn (Fig. 1). The distributions were plotted on the basis of number of identifiable pieces. Small trashy pieces and long hairlike strips of stems were not included.

The flywheel-type chopper was set for a theoretical length of cut of ½ in. and about 60 percent of the pieces were within ¼ in. of the theoretical setting. The grass cut with the Lundell standard machine was much less uniform

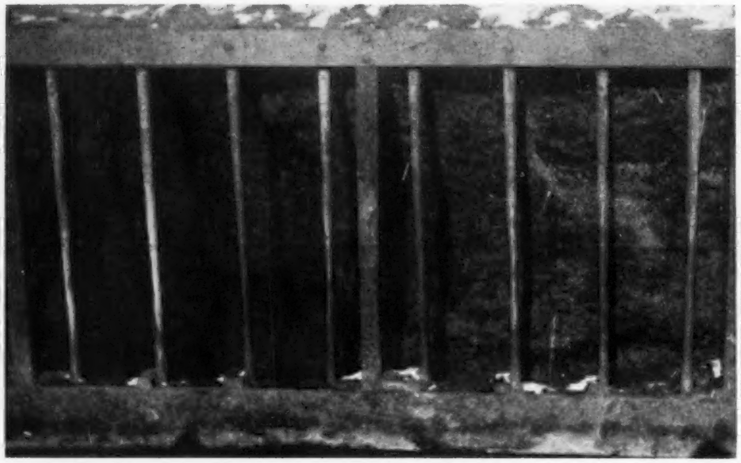


Fig. 7 Experimental section of trench silo showing tendency of cattle to eat into chopped material first. Note shadows of bars on left side containing the chopped silage

. . . Shredded Silage

in length. The average length was 2.34 in. as compared to the 0.88 in. for the conventional chopper. The Lundell economy machine gave an even less uniform length of cut than the standard machine and had an average length of 3.48 in.

Some of the factors which affect the length of cut produced by the flail-type forage harvester are relationship of forward speed to rotor speed, design of the knives or hammers and type and maturity of the crop being cut. The effect of these various factors were not investigated for this study.

Moisture or juice on the surface. The shredded grass was more moist to the touch than chopped grass. The lacerating action of the shredding machine liberated a considerable portion of the contents of the plant cells. A surface damage indicator was constructed which consisted of a steel cylinder 8 in. long and 3½ in. in diameter, in which calcium carbide was made to react with the moisture on the surface of the grass. The reaction liberates larger quantities of gas. A 50-g sample of grass was used with 30 g of powdered calcium carbide. The rate of pressure rise in the cylinder was measured as an index of the amount of surface damage of grass after being cut. The curves shown in Fig. 2 indicate that the grass cut with the Lundell standard was more damaged than the chopped grass. The Lundell economy machine gave somewhat less damage than the chopper. All of the machines damaged the grass considerably more than the long grass cut only with the mower.

Texture of the material. The texture of the grass cut by the different machines can best be described by photographs showing the nature of the cut. Figs. 3, 4, 5, and 6 are photographs of grass cut by the various machines. The fine shreds can be seen in the Lundell standard material (Fig. 5), while the chopped material (Fig. 4), has been rather cleanly cut and only a few leaves have been bruised. Fig. 3 indicates that the Lundell economy machine shreds the stems to some extent, but leaves them long. The material cut with a mower (Fig. 6) is relatively undamaged.

Field Studies

Experimental work was carried out for two years utilizing a trench silo as the storage structure. Forage cut with the Lundell standard machine and conventional forage harvesters was ensiled in the following manner. A 10-ft section of the silo was filled so that one-half of the width of the silo was shredded material and the other half was chopped material. Thermocouples were placed in the grass during filling and temperatures were read throughout the ensiling period. The silage was self-fed from the trench. Observations were made of cattle preference, and analyses were made for carotene, crude protein, dry matter, and pH.

Procedures used in carotene and crude protein analysis may be found in reference 2. A chromatographic column was used for carotene. The Kjeldahl determination was used for crude protein. Dry matter determinations were made by drying 25 g samples in an oven at 105 to 110 C. for 24 hours. A water extract and a Beckman Model H2 pH meter were used in making pH determinations.

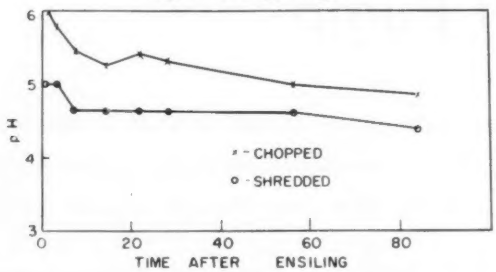
Results obtained from the two-year study showed that there was little or no difference between the silages in carotene, crude protein, dry matter, and pH. Although the feeding was not done on a feeding trial basis, the observation was made that there was an apparent cattle preference for the chopped silage. Several times during the feeding period the face of the experimental silage was evened off. The cattle immediately ate in on the chopped silage and ate the shredded silage after they could no longer reach the chopped silage(Fig. 7). This might be attributed to the greater ease of eating the chopped silage. However, it must be emphasized that this was not a controlled feeding trial and that many factors could have influenced the results.

Temperatures were recorded during the ensiling period. It was found that even though the silages were well compacted, temperatures were still quite high. Both shredded and chopped grass reached 137 F. shortly after being placed in the trench but cooled down some as filling and compaction continued. There was little or no difference in temperature between the silages.

Laboratory Studies

The large number of variables in the ensiling process make the evaluation of the effect of any one treatment extremely difficult. Since a great deal of control can be exerted on experimental conditions where silage is made in laboratory containers under laboratory conditions, it would be

Fig. 8 Changes in pH



desirable to depend heavily on laboratory techniques in silage studies.

Several comparisons were made between chopped and shredded silage under laboratory conditions. One of these comparisons gave information as to how changes occur with time in the ensiling period. Experimental silage was made in one-gallon jars from chopped and shredded alfalfa. Eight jars of each material were put up, each jar contained 4 lb of silage. Pairs of jars were opened at intervals over the period of about three months. Analyses were made on the silage for carotene, protein, pH and acids present. In Fig. 8 it can be seen that pH in shredded silage quickly dropped to a lower value than the chopped silage and maintained that condition throughout the experiment. Carotene dropped rapidly during the first few days but then rose to a much higher level in the shredded silage (Fig. 9). Although the rise in carotene content may seem unusual, it has been reported with explanations by several investigators (4). Fig. 10 shows that there was little difference in the crude protein content of the silages. The shredded silage had higher percentages of acetic and butyric acids (Fig. 11).

Another experiment was designed to relate information found in the laboratory to that found in the field. As the trench silo was filled in the summer of 1954, twenty-four one-quart glass jars were filled with one pound of grass each. Twelve of the jars (silo jars) were placed in the silo. One-half of the jars contained shredded grass and the others contained chopped grass. The other twelve jars (lab jars) were stored in a laboratory cabinet.

As the silage was fed out of the trench during the winter, the jars were removed and samples were also taken of the adjacent silage for analysis. Average values of results obtained are shown in Table 1.

TABLE 1. COMPOSITION OF CHOPPED AND SHREDDED SILAGE FROM SEVERAL SOURCES

Silage	Constituents: Carotene, unit per gram D.M.	Crude protein, percent D.M. basis	Dry matter percent	pH
Silo jars				
chopped	238	23.5	16.4	5.94
shredded	223	22.3	16.5	5.71
Silage				
chopped	254	18.3	19.6	5.20
Shredded	240	19.2	17.6	5.25
Lab jars				
chopped	207	22.2	18.8	5.32
shredded	184	21.4	17.4	5.24

Tests of signficance were applied to the data and differences were determined at the 5 percent level. The results of this statistical treatment indicate that there was no significant difference between chopped and shredded material in pH. There was a significant difference between storage methods on the pH values. Examination of the data showed that the differences in pH were between the silage from the trench and the silage from the silo jars. There was no difference between trench silage and lab jar silage.

No significant difference in crude protein was found between chopped and shredded silages. The storage method again showed a difference, but in this case, the lab jar silage and the silo jar silage were most nearly alike.

(Continued on page 605)

Fig. 9 Carotene

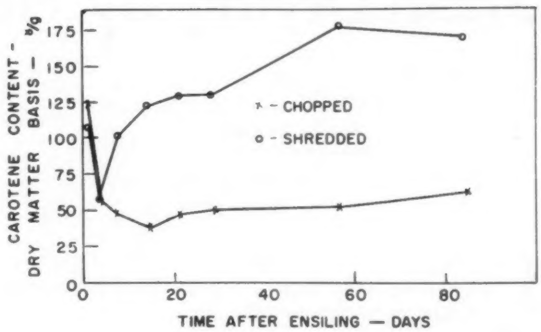


Fig. 10 Protein

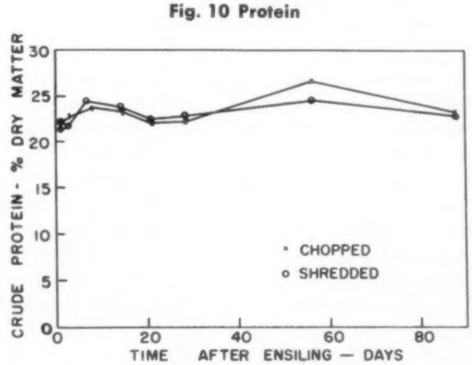
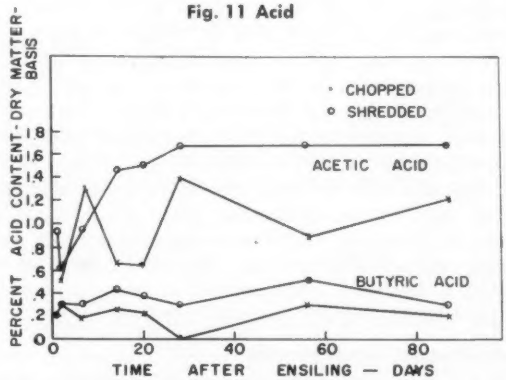


Fig. 11 Acid



Figs. 8, 9, 10 and 11 Changes in pH, carotene, protein, and acetic and butyric acid contents are shown for 70 percent moisture content alfalfa ensiled in one-gallon jars and opened at intervals of 1, 3, 7, 14, 21, 28, 56, and 84 days

Grain Drying by Heat Pump

A. M. Flikke
Member ASAE

H. A. Cloud
Assoc. Member ASAE

A. Hustrulid
Member ASAE

Work and results of tests carried on at the University of Minnesota over a two-year period show capabilities and limitations of the heat pump for use in grain drying

THE heat pump principle offers an excellent method of conditioning air for grain drying. The temperature and relative humidity of the drying air can be controlled by careful selection of the equipment used in the drier. In addition, the heat pump, used in a closed cycle, is able to reclaim the heat normally being carried away in the evaporated water.

Fig. 1 shows how the heat pump was used to dry corn and oats during the period 1954-1955. Beginning after the air leaves the grain, the moist air passes over the evaporator *(D)* where it is cooled below the dewpoint and some of the water is condensed. The air then passes over the compressor *(B)* and condenser *(C)* and is warmed a considerable amount. It then enters the grain bin and picks up moisture and is ready to repeat the cycle. Thermodynamically, the evaporator *(D)* absorbs sensible and latent heat from the moist air. The compressor *(B)* delivers this heat plus the heat equivalent of the work done on the refrigerant to the condenser *(C)* which in turn gives it up to the air passing over it where it is absorbed as sensible heat. Thus the unit is reclaiming the heat in the evaporated water and using it at a cost equal to that of operating the compressor motor.

Previous work (1)* has concluded that on a theoretical basis the heat pump can be operated on a competitive basis with other fuel for grain depths up to 2½ ft. This theoretical study indicated that further study was needed to determine some of the economic factors involved in the problem of using this method of air conditioning for grain drying.

In order to evaluate the heat pump method described above, a laboratory scale, closed system heat-pump, crop-drying unit was built and basic data on its operation obtained. A description of this method, its use and the findings of a conducted study are covered in this article.

Experimental Arrangement

Fig. 1 shows the arrangement of the equipment in the drier. A bin with a floor area 4 ft by 4 ft was constructed with a screen floor. A metal duct system with soldered construction was used to convey the air from the bin and over the heat pump. The refrigerating unit *(B)* was a ¾-hp unit using F-12 as the refrigerant. A 12-in. backward curved centrifugal blower *(E)* powered by a ½-hp motor *(F)* was used to circulate the air. A belt arrangement was used to provide a wide range of fan speeds.

A water-cooled coil *(G)* was installed for the purpose of controlling the maximum drying temperature. This was located at the fan discharge and was operated by a thermostat located in the air stream beneath the grain bin. Thermocouples were used to measure the temperature change of the quantity of water used.

Instruments were provided to measure the wet and dry bulb temperatures of the air throughout the process and to measure the pressure, quantity and temperature of the refrigerant as it passed through the cycle. A velometer calibrated with a thin plate orifice was used to measure air flow. The orifice was removed during the tests to eliminate energy losses across it. Records were kept of the energy used, weights of grain and the operating time. The condensate at the evaporator was collected and weighed at hour intervals. Moisture contents of the grain were determined by use of a Brown-Duvel moisture tester.

The basic data for this study consisted of the moisture removed and energy expanded in doing so. Other data were taken to determine the operating characteristics and will be presented along with the cost data.

Experimental Procedure

The grain to be dried was harvested at the moisture content desired for the tests. Uneven ripening of the oats resulted in a moisture content higher than that usually encountered in practice. Enough corn and/or oats was sealed in polyethylene bags and stored at 0 F to provide for eight tests with each particular crop. This procedure provided grain at nearly the same initial moisture content for each test. The bin was filled to a depth of one foot and was placed in the bin after being allowed to thaw and warm to approximately 50 to 60 F. This required 500 lb of oats or 750 lb of corn. Samples for moisture content were taken and the temperatures of the grain at various points in the bin were read, after which the bin was sealed and the test begun.

The two controlled variables in the study were air flow and drying air temperature. Air flows were approximately 275, 525, 775, and 1,000 cfm. Tests were conducted at each air flow with maximum drying air temperatures of 110 F and 130 F using shelled corn and oats, giving a total of 16 trials. When the grain had dried to about 12 percent (w.b.), the test was stopped and the final measurements were made.

Energy Requirements

Table 1 and Figs. 2 and 3 summarize the energy requirements of the heat pump drier used in these tests. The energy requirements can be divided into two parts, energy to the blower motor and energy to the compressor. The energy needs to both components of the system vary with the air

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*Numbers in parentheses refer to the appended references.

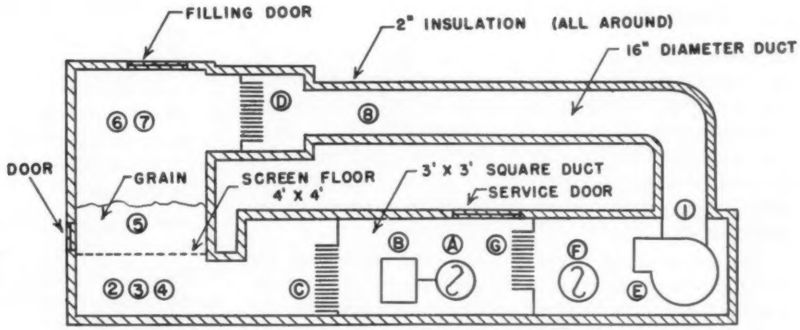

Fig. 1 Schematic diagram of experimental heat pump grain drier showing location of equipment and measuring instruments

EQUIPMENT

A Compressor motor
B Compressor
C Condenser
D Evaporator
E Fan
F Fan motor
G Water-cooled coil

INSTRUMENTATION

1 Three thermocouples (averaged)
2 Four thermocouples (averaged)
3 Wet and dry bulb thermocouples
4 Relative humidity element
5 Thermocouple probe (3 in. apart)
6 Four thermocouples (averaged)
7 Wet and dry bulb thermocouples
8 Calibrated velometer (air flow)

flow. The basic variable in the study was the air flow which has been used as the base for discussion of the results.

There was the expected increase in the energy consumption of the fan motor as air flow was increased. In order to have an efficient refrigeration system the suction and discharge temperatures should be as close to each other as possible, consistent with operating conditions. Raising the evaporator temperature by either increasing the air flow or raising the drying air temperature provides these favorable conditions and increases the refrigerating capacity of a unit. Table 2 (column 3) shows how the quantity of heat absorbed at the evaporator increased with an increase in air flow. This column also shows that higher drying air temperatures increases the capacity of the unit, comparing oats to oats and corn to corn for 110 F and 130 F drying air. For this unit and a given drying air temperature, the temperature of the air leaving the grain and entering the evaporator was dependent on the air flow. However, increasing the air flow results in a more rapid increase in the blower energy used (Figs. 2 and 3) until the energy cost exceeds the benefits gained.

Balanced against the higher blower energy cost is the reduced cost of operating the compressor unit. This cost does not decrease at the same rate that fan costs increase, in fact, it does not change materially after an air flow of 800 cfm is reached.

From these relationships it can be shown that there is an air flow that results in a minimum total energy cost. The top curve in Figs. 2 and 3 illustrates this. These figures show the energy input to the fan and to the compressor and the total input on the basis of removing a pound of water. During the tests the fan was operated by a ½-hp motor through a jack shaft arrangement to give flexibility in the selection of fan speeds. This method was inefficient at low fan speeds and in order to determine the actual energy required to drive the fan, the efficiency of the motor was determined and also

TABLE 1. SUMMARY OF ENERGY REQUIREMENTS — 1955

Test No.	Total weight in lb	Moisture content percent (w.b) in	out	Operating time hr	Air flow cfm	Control air temp., F	*Input to blower, kw-hr	†Corrected input to blower, kw-hr	Input to compressor kw-hr	‡Total energy, kw-hr	Condensate collected, lb	Total water removed, lb	Energy per lb water removed—kw-hr Total
	1	2		3	4	5	6	7	8	9	10	11	12
Oats													
55-2	500	29.5	13.5	12.00	275	110	3.52	0.82	10.82	11.64	90.41	93.38	.125
55-4	500	27.9	11.2	10.50	520	110	3.35	1.99	9.69	11.68	85.98	92.25	.127
55-6	500	28.8	12.4	10.00	800	110	5.18	4.17	9.05	13.22	83.29	91.12	.145
55-7	500	28.2	12.4	10.00	1100	110	9.08	8.40	9.12	17.52	88.27	91.44	.192
55-1	500	27.3	10.0	12.50	250	130	3.86	0.75	13.03	13.78	89.41	99.63	.139
55-3	500	28.3	10.4	9.50	490	130	3.03	1.63	10.28	11.91	94.18	98.93	.120
55-5	500	28.5	11.4	8.75	780	130	4.61	3.45	9.29	12.74	92.34	99.12	.129
55-8	500	29.3	11.4	8.00	1100	130	6.99	6.71	8.51	15.22	89.31	96.31	.158
Corn													
55-12	750	26.0	13.2	13.75	270	110	3.70	0.90	12.11	13.01	94.80	100.50	.130
55-10	750	24.8	13.1	12.50	530	110	3.65	2.44	10.81	13.25	91.25	99.69	.133
55-16	750	24.6	13.4	12.00	770	110	4.71	4.62	10.00	14.62	90.03	97.75	.149
55-13	750	24.8	14.2	11.75	950	110	7.13	7.05	9.79	16.84	90..92	97.81	.172
55-11	750	24.8	12.6	13.75	270	130	3.28	0.90	14.02	14.92	95.48	105.31	.142
55-9	750	24.2	13.1	11.25	530	130	3.23	2.19	10.82	13.01	94.67	102.00	.127
55-15	750	25.0	13.4	10.68	750	130	4.34	4.26	9.33	13.59	89.94	97.12	.140
55-14	750	25.5	13.3	11.00	950	130	6.16	6.60	9.72	16.32	95.36	102.31	.159

*Actual input during tests using ½-hp motor and jack shaft.
†Direct-coupled motor with 70 percent efficiency (calculated).
‡Using corrected blower input.

the power needs without using the jack shaft to drive the fan. Using these relations a corrected energy input to the fan was determined, using 70 percent as the efficiency of this calculated input. A comparison of columns 6 and 7 in Table 1 shows a great difference at the lower air speeds when the efficiency of the ½-hp motor is low and the jack shaft absorbs a considerable portion of the energy supplied to the blower setup.

For the drier the minimum cost in kilowatt-hours per pound of water removed from the grain reached a minimum at an air flow of 400 to 500 cfm. The value varied with the maximum drying air temperature being 0.127 kw-hr per lb of water with the air at 110 F and 0.124 kw-hr per lb using air at 130 F. These values approach very closely the predicted values (1).

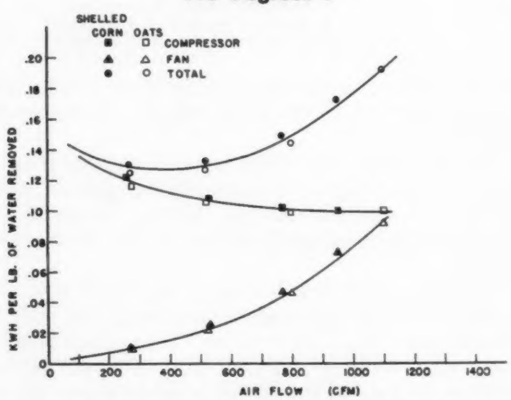

Fig. 2 *(Above)* The effect of air flow upon the kw-hr of electricity needed to remove a pound of water from the grain with a drying air temperature of 110 F

Fig. 3 *(Right)* The effect of air flow upon the kw-hr of electricity used to remove a pound of water from the grain with a drying air temperature of 130 F

Factors Influencing Operating Costs

There are many factors that influence the cost of operating the heat pump and one of the most important is air flow over the unit. Some of the quantities which depend on the air flow are: temperature of air leaving grain; relative humidity of air entering grain; grain temperatures in bin and moisture content from top to bottom of the grain at time test is completed.

Air Flow and Temperature—To illustrate the effect of air flow on operating conditions of the heat pump, the results of two tests are plotted in Fig. 4. On this diagram are shown the air conditions entering and leaving the grain for air flows of 275 cfs and 1100 cfm.

From the curves it is seen that the air leaving the grain is 20 to 25 F warmer at the higher air flow. This causes a corresponding increase in the evaporator temperature which gives a more favorable refrigeration cycle. This is shown in Fig. 5, where the refrigeration cycles are plotted for these two tests. Increasing the air flow from 275 cfm to 1100 cfm raised the evaporator temperature 26 F as compared to a condenser temperature increase of only 6 F.

Coupled with this increase in evaporator temperature is an increase in the refrigerant flow and consequently a

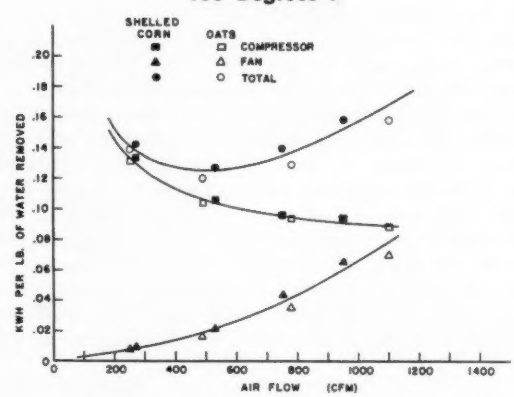

TABLE 2. HEAT AND TEMPERATURE CONTROL DATA

Test No.	Ambient air temp., F	Initial grain temp., F	Heat absorbed at evaporator, Btu/hr*	Time of test, hr.	Time on control temp., hr	Heat added, Btu/hr	Heat removed during control period, Btu/hr
	1	2	3	4	5	6	7
Oats							
55-2	85	56	11,640	12.00	10.00	4070	3960
55-4	91	58	14,600	10.50	7.50	4300	3360
55-6	83	54	15,950	10.00	6.25	5020	3280
55-7	82	60	17,270	10.00	7.00	6350	4500
55-1	82	62	12,650	12.00	8.00	5090	1220
55-3	89	61	16,500	9.50	3.50	5230	1540
55-5	87	60	18,080	8.75	2.75	6020	2560
55-8	87	61	19,750	8.00	2.00	7200	3500
Corn							
55-12	75	50	11,200	13.75	9.75	4040	3560
55-10	80	46	14,600	12.50	6.00	4170	2450
55-16	76	45	16,100	12.00	4.00	4550	2200
55-13	73	50	16.650	11.75	4.75	5210	2270
55-11	78	49	12,750	13.75	6.00	4700	2080
55-9	78	43	15,260	11.25	0.00	5150	0
55-15	77	48	16,800	10.50	†	5160	†
55-14	77	47	16,900	11.00	†	5880	†

*Based on refrigerant flow and enthalpy change.
†Tests did not reach control temperature of 130 F.

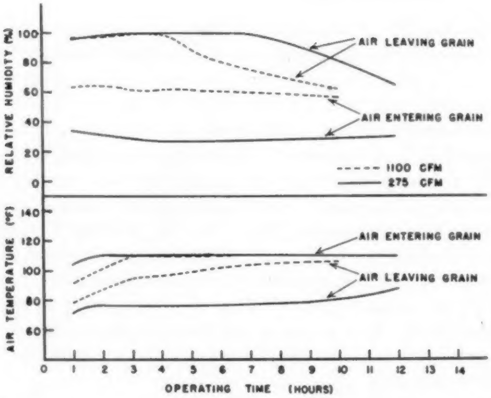

Fig. 4 Air conditions entering and leaving the grain at low and high air flows

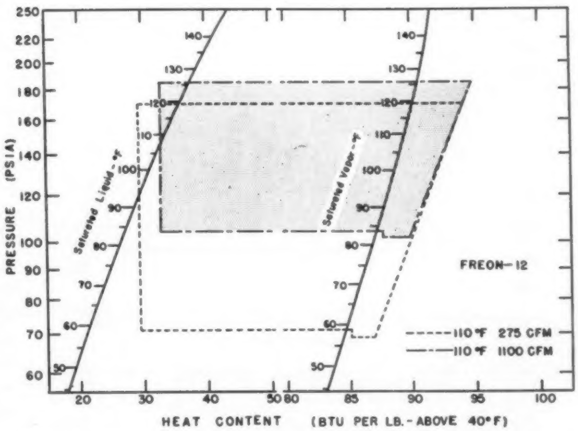

Fig. 5 Mollier diagram showing the refrigeration cycles and the effect of increasing the air flow on evaporator temperature

greater refrigeration capacity. The increase in refrigerant flow makes it possible to remove water at a faster rate from the grain. However, these increases which are favorable to the heat pump operation require a greater energy input to the fan motor.

A factor not related directly to air flow but one that influences operating conditions of the heat pump is the maximum drying air temperature. Fig. 6 shows air conditions for different drying temperatures at the same air flow (250-275 cfm). It also can be seen that the temperature difference between the air entering and leaving the grain is approximately 7 F greater at the higher entering air temperature. Even with this greater spread, the air entering the evaporator is warmer and results in a more favorable refrigeration cycle. This is shown in Fig. 7 which shows the two tests plotted on a mollier diagram. This too points to the fact that changing the air flow results in a higher evaporator temperature which brings about a greater refrigerating capacity and that this must be considered in the design of a heat pump drier.

Relative Humidity — Another consideration in the use of the heat pump for drying grain is that it is possible for a given drying air temperature to control the relative humidity of this air by changing the air flow (Fig. 4). As pointed out previously this also changes the refrigeration capacity of the system and affects the operating cost. However, with crops that require critical drying conditions, a heat pump drier can be used to an advantage. These cost relationships must be weighed against the additional benefits derived from having the required air conditions for drying whenever the design of a unit is undertaken. Fig. 8 shows how the relative humidity of the drying air increased as the air flow increased for these particular tests, showing a range from 30 to 60 percent obtained by changing the air flow. This range in relative humidity can also be achieved by changing the refrigeration capacity of the system.

The relative humidity of the air coming off the grain while drying (Fig. 4) is dependent upon the moisture content of the grain. It remains at near saturation until drying is nearly completed at which time it begins to decrease and the temperature of the air begins to increase. As the moisture content of the grain decreases, evaporation of the water does not take place as readily and consequently the air is not saturated when it leaves.

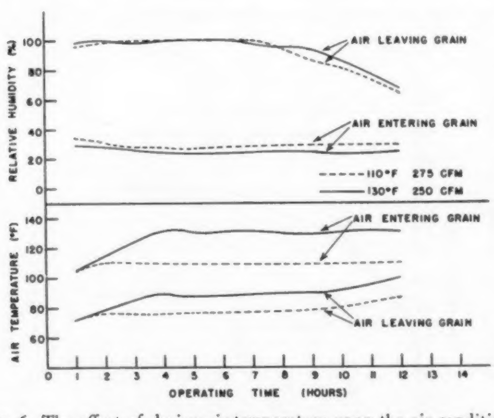

Fig. 6 The effect of drying air temperature upon the air conditions entering and leaving the grain

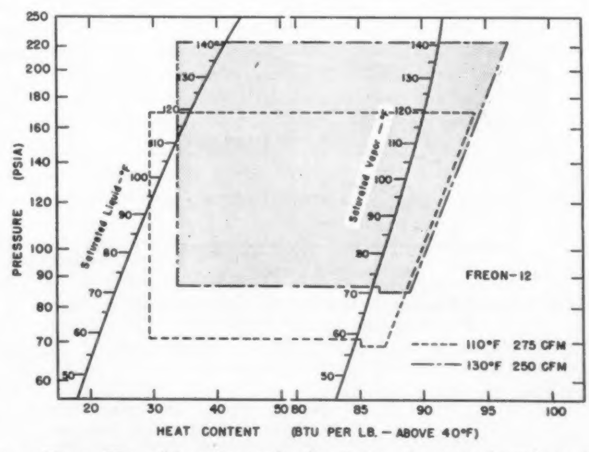

Fig. 7 The refrigeration cycles for drying air at 110 F and 130 F with the same air flows. High drying air temperatures raise the temperature of the air off the grain and into the evaporator

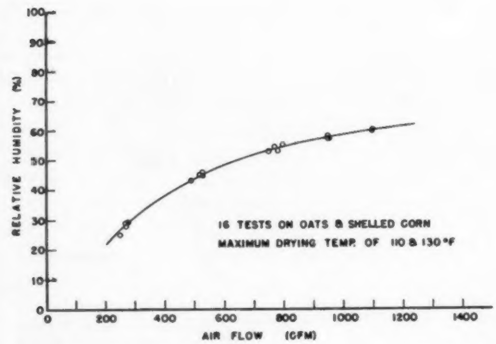

Fig. 8 The effect of air flow upon the relative humidity of the drying air

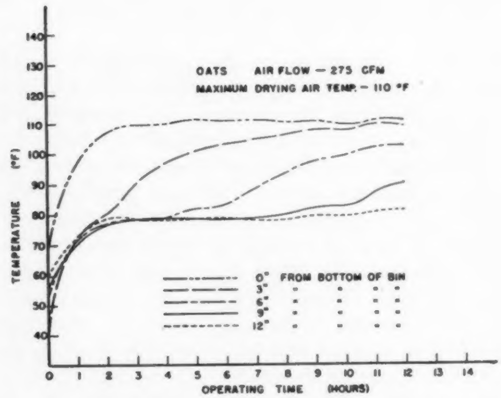

Fig. 9 Temperature distribution in the grain bin at an air flow of 275 cfm and 110 F drying air

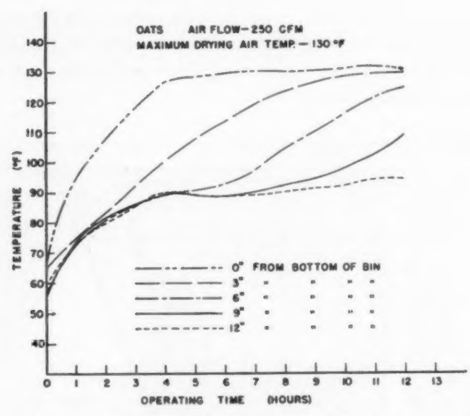

Fig. 10 *(Above)* Temperature distribution in the grain bin at an air flow of 250 cfm and 130 F drying air

Fig. 11 *(Right)* The effect of a high air flow upon the temperature distribution in the grain bin

. . . Heat Pump

Drying Air Temperature—It has been established (3) that heated air for drying seed grain should not exceed 110 F, while 130-140 F is permissible for grain to be processed. Tests were made at 110 F and 130 F in order to determine the differences, if any, in the operation of the drier. Referring to Fig. 4, at the lower air flows, there is a rapid increase in the air temperature until it reaches the maximum allowable drying temperature, but a higher air flow did not permit such a rapid temperature rise. The air leaving the grain warms at about the same rate until the control temperature is reached. Near the end of the test, the temperature of the air leaving the grain begins to rise as the drying capacity is not fully utilized. This is due to the lower moisture content of the grain which causes the air to leave the grain at a lower relative humidity.

Figs. 9, 10 and 11 show how the temperatures in the grain bin varied from top to bottom with changing air flows and drying air temperatures. The grain in the bottom zone begins to dry immediately and warms up in a short time. The drying air carries this moisture to the top of the bin and in doing so warms the grain as it passes through. This process continues until the grain is dried. With high moisture contents, evaporative cooling slows down the warming of the grain and temperature plateaus or zones are developed which separate one by one as the grain dries. This increase in grain temperature after the drying front has passed is particularly noticeable at the low air flows (Figs. 9 and 10). The final temperature of the grain varies from zone to zone and depends upon the final moisture content. Table 3 shows the temperature-moisture relations in the bin at the completion of drying. The temperature gradient from top to bottom is greater for a low air flow and a similar relation exists in the moisture gradient. High air flows lower both the temperature and moisture gradients in the bin.

Rate of Removing Water—Fig. 12 shows how the rate of removing water from the grain varied during the test period. The amount of water removed per hour increases rapidly until a certain rate is reached. This rate is determined by the air flow and drying air temperature. The apparently small amount of water removed the first hour is because the surfaces of the coils and collection pan and other parts of the system accumulate a certain amount of moisture before condensate appears at the drain. Not all of the water

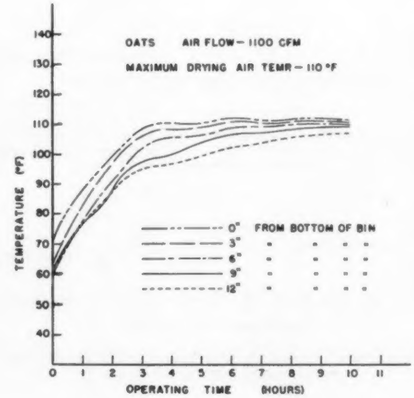

TABLE 3. TEMPERATURE — MOISTURE RELATIONS IN DRYING BIN

Test No.	Temperature - degrees F at end of test depth - inches					Moisture content percent (w.b.)			
	0	3	6	9	12	In	Top	Bottom	Composite
Oats									
55-2	111	110	103	90	81	29.5	27.3	8.2	13.5
55-4	111	110	108	104	100	27.9	17.2	9.4	11.2
55-6	111	110	109	107	104	28.8	16.4	10.9	12.4
55-7	111	111	110	109	107	28.2	14.3	11.8	12.4
55-1	131	130	125	109	94	27.3	23.9	5.5	10.0
55-3	131	130	126	120	107	28.3	19.8	8.1	10.4
55-5	131	130	128	125	114	28.5	18.4	9.3	11.4
55-8	130	129	128	126	122	29.3	16.9	10.8	11.4
Corn									
55-12	111	109	106	99	87	26.0	21.5	11.6	13.2
55-10	111	109	108	105	99	24.8	17.0	13.4	13.1
55-16	111	110	109	108	104	24.6	15.9	12.0	13.4
55-13	109	108	107	106	103	24.8	16.4	14.2	14.2
55-11	131	129	125	114	97	24.8	20.8	10.4	12.6
55-9	131	129	125	119	111	24.2	19.3	12.8	13.1
55-15	124	122	121	116	110	25.0	18.8	14.2	13.4
55-14	126	124	123	120	115	25.5	16.2	13.4	13.3

taken from the grain was recovered at the condensate drain. In an attempt to measure these losses, a separate test was run in which the water in the ducts and on the coils was measured as far as possible and this reduced the loss to 2½ percent compared to an average of 6 percent in the actual tests.

Toward the end of the test the rate begins to drop due to insufficient readily available water in the grain to saturate the air as it passes through the grain. Also drawn on Fig. 11 is the compressor power consumption in kilowatt-hours. This shows a steady increase until the controlled temperature of the drying air is reached at which time it levels off.

Heat Removal to Maintain Drying Air Temperature— Continuous addition of energy to the closed cycle being used in these tests resulted in a temperature rise of the system. The only losses are by conduction through walls and air exchange with the outside due to leaks. The temperature of the system begins to rise immediately at a rate influenced by the amount of grain in the bin, energy input and the ambient temperature. If the drying temperature is to be controlled, heat may have to be removed sometime before the drying is completed. This was true for these tests except for the last three on corn at 130 F which did not reach this temperature

Fig. 12 Graph showing the rate of removing water from the grain during the test. At the top is the power in kilowatts being used by the compressor motor

before the end of the test. This was caused somewhat by the greater quantity of corn (750 lb) than oats (500 lbs) in the bin which absorbed a considerable amount of heat during the test. These data are summarized in Table 2 (columns 4, 5, 6 and 7).

Summary

In conclusion, the closed cycle heat pump grain drier is capable of doing a good job of drying grain with favorable energy requirements. It is capable of producing closely controlled drying air conditions necessary for processing some crops. Relative humidity control may be achieved by balancing the air flow and refrigeration capacity depending upon the load of the drier. Control of maximum drying air temperature must be provided for in most applications. Data have been presented as to the capacity of a heat pump drier and the application becomes one of selecting the proper equipment to supply the drying needs of a particular crop. Projecting these data to the design of a larger unit the following relationships exist: For every six pounds of water removed per hour, a refrigerating capacity of 10,000 Btu per hour must be provided. To operate at minimum energy requirements for drying, an air flow of 320 cfm must be provided for every 10,000 Btu per hour refrigerating capacity. The disadvantage of a heat pump drier is the initial investment to provide a reasonable drying capacity. However, if closely controlled air conditions are needed, this first cost may be feasible when compared to other methods. The air conditions needed for a particular crop will, for the most part, determine whether or not the unit can be operated at minimum energy needs. In many applications the heat pump grain drier can compete favorably with other types of heated air driers.

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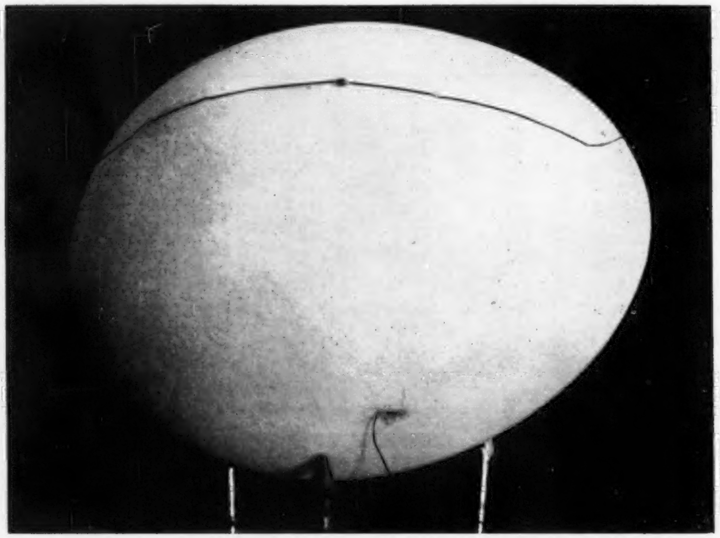

Fig. 1 Thermocouples were fastened to the surface and strung through to the center. The holes were sealed with household glue

On-the-Farm

S. M. Henderson
Member ASAE

COLD storage rooms for eggs may be used on the farm to minimize drops in grade (and value) between the time eggs are laid and the time of delivery to market. Yolk flattening and albumen weakening are fostered by high temperatures, and appreciable moisture is lost under high temperatures and low relative humidities.

Authorities generally agree that interior quality (yolk and albumen stability) can be maintained during the normal three-to-seven-day ranch-storage period if eggs go into cooling two or three hours after being laid and are held at temperatures below approximately 60 F (2, 3)*. Weight loss, which affects air-cell size, can be appreciable if the relative humidity of the storage room is low. Considerable latitude in the above conditions will preserve a satisfactory grade on the farm, but any small quality decrease is nevertheless cumulative, and may eventually affect the grade at the wholesale or retail level. Therefore, farm egg-cooling-and-holding facilities should be designed for the best performance consistent with reasonable cost and reasonable labor needs for conducting the enterprise.

Since the cooling of eggs from laying house temperature to storage temperature may account for one half to three fourths of the total refrigeration requirements, a study of the cooling of warm eggs was considered essential to establish optimum design and management procedures. Likewise, the effect of relative humidity and temperature on moisture loss was studied so that optimum design proposals could be further refined. The moisture loss studies will be published as part II of this paper.

Part I of a paper presented at the annual meeting of the American Society of Agricultural Engineers at Roanoke, Va., June, 1956, on a program arranged by the Rural Electric Division.

The author—S. M. Henderson—is associate professor of agricultural engineering, University of California, Davis.

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*Numbers in parentheses refer to the appended references.

The Egg

The features of a standard or average hen's egg that are relevant to engineering considerations are (6): weight, 58 gm; volume, 53.0 ml; major diameter, 5.7 cm; minor diameter, 4.2 cm; distance from minor diameter to blunt end, 2.6 cm; surface area, 68.0 sq cm; specific gravity, 1.08-1.09; specific heat, 0.772; weight percentages—shell 11, albumen 58, yolk 31. The equilibrium vapor pressure is approximately that of pure water. At the instant an egg is laid there is no air cell; within a few minutes (as cooling starts) an air cell is formed with a diameter of about 1.5 cm.

U.S. grade factors based on candled appearance are summarized as follows (5):

Quality	Shell	Air cell	White	Yolk
AA	Clean, unbroken practically normal	⅛ in. or less deep, practically regular	Clear, firm	Well centered, outline slightly defined, free from defects
A	Clean, unbroken, practically normal	¼ in. or less deep, practically regular	Clear, reasonably firm	Fairly well centered, well defined, practically free from defects
B	Clean, unbroken, may be slightly abnormal	⅜ in. or less deep, may move not over ⅜ in., if not over ¼ in. may be free	Clear, may be slightly weak	May be off center, outline well defined, may be slightly enlarged and flattened, may show definite but not serious defects
C	Clean, unbroken, may be abnormal	May be over ⅜ in. deep, may be free or bubbly	Clear, may be weak and watery, small blood clots or spots may be present	May be off center, enlarged and flattened, may show clearly visible germ development but no blood, may show other serious defects, outline plainly visible.

Egg Processing

Part I — COOLING

Quality lost during the "ranch-storage" period can not be restored after eggs are taken to market. Part I deals with on-the-farm egg cooling. Part II, to be published later, reports on moisture losses

U.S. weight classes for consumer grades AA through C are summarized as follows (5):

Size or weight class	Minimum net weight per dozen	Minimum weight for individual eggs at rate per dozen
Jumbo	30 oz.	29 oz.
Extra large	27 oz.	26 oz.
Large	24 oz.	23 oz.
Medium	21 oz.	20 oz.
Small	18 oz.	17 oz.
Peewee	15 oz.	—

Grade and weight factors are not related in U.S. standards. Retail organizations sometimes limit the size and grade brackets to give the public a more uniform product.

Basic Cooling Rates

Ten eggs ranging from 57 to 66 gm in weight were fitted with 36-gage copper-constantan thermocouples as shown in Fig. 1. The eggs were warmed to a uniform temperature of 78 F and then moved to a constant-temperature room at 38½ F. They were supported as shown in Fig. 1, and temperatures were noted by a potentiometer as they were cooled. Approach air rates for each egg were measured by a calibrated vane anemometer. The results were not satisfactory since the air was found to surge in the vicinity of certain eggs and variations in egg size confused any resolution of air-rate effect upon cooling time.

A second series of studies with a single egg eliminated the size variable. Two surface thermocouples were used, one fore and one aft the air stream, in addition to the center couple. The egg was put through four cooling tests at different air rates. The egg, positioned small end down, was placed where air movement was consistent and uniform. It was cooled from about 100 F to two or three degrees above room temperature in a 44 F room.

The egg used was less than a day old, weighed 59½ gm, and had major and minor axes of 2.16 in, and 1.73 in., respectively.

The writer admits the inadvisability of using data from a single biological unit to predict performance of similar units under different conditions. However, since normal eggs are relatively uniform and since observation of the air rate effect was a prime requirement, the single-egg-procedure appeared proper.

The results (Fig. 2) are plotted in a manner developed by Gurney and Lurie, who prepared charts of transient conduction cooling of solids (1, 4).

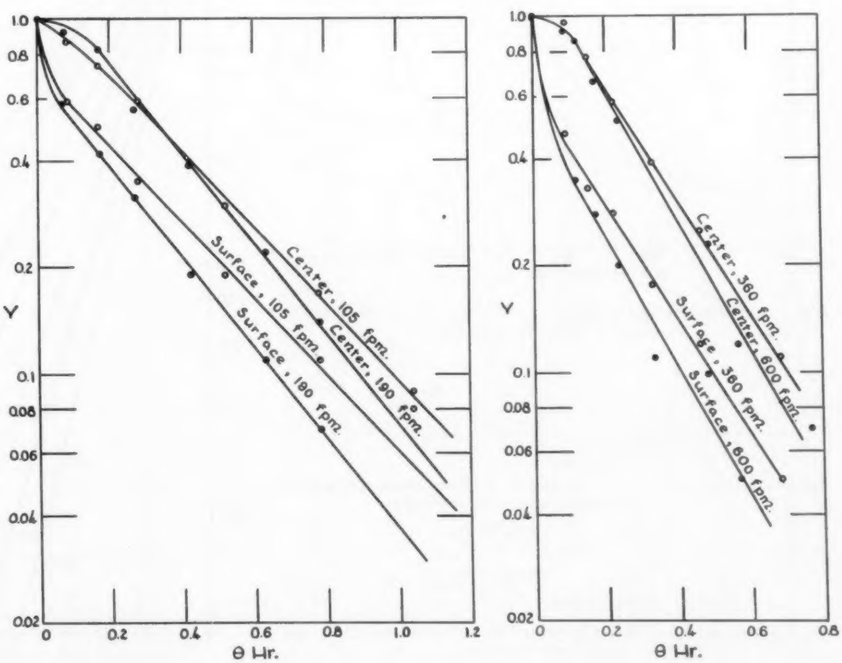


Fig. 2 Surface and center-temperature ratios, *Y*, for a single egg cooled at four air rates are shown on two graphs

. . . Egg Cooling

$Y = t - t_a / t_i - t_a$

t=temperature after a period of time, hr

t_i=initial egg temperature, F

t_a=temperature of cooling air, F

θ=time, hr

Note that after a short time the center and surface curves become parallel. This feature, being characteristic of the cooling process defined by Gurney and Lurie, is an index of the validity of the data.

The equation for the straight portion of the cooling curves is

$$\ln Y_1 - \ln Y_2 = -m(\theta_1 - \theta_2)$$

from which m, the slope of the straight portion of the curves, was found to be

for 105 fpm	2.49 hr^{-1}
for 190 fpm	2.86 hr^{-1}
for 360 fpm	3.53 hr^{-1}
for 600 fpm	4.20 hr^{-1}

The slope indices and θ for center temperatures at $Y=0.1$ for the air rates of the tests are plotted logarithmically in Fig. 3. Data from the Fig. 3 plot were used to prepare Fig. 4, which can be used for estimating the cooling times of normal-size eggs at various air rates. A similar curve for surface temperatures could be prepared if desired.

The hazard of extrapolation is recognized in presenting Fig. 4. However, the data of Fig. 3 do not foreshadow a significant deviation from the power function assumed in using this plot. Consequently, reasonable extrapolation is believed permissible.

Cooling in Containers

It is not practical to use the basic cooling data previously presented to predict egg cooling rates in containers. Cooling rates in conventional egg containers were made under various air-flow conditions so that containers could be compared as regards cooling effectiveness, so that the importance of air rate could be evaluated, and, finally, so that recommendations for design and management could be made.

The containers of Fig. 5 were studied. The *basket*—diameters of 14 in. and 10½ in., top and bottom, respectively and 10 in. high—held 124 eggs when filled, as shown. *Case packing systems*—consisting of filler and flat combinations (holding 36 eggs each) and filler-flats (holding 30 eggs each)—were compared. Ten of the former and 12 of the latter were used per case; thus a full case held 30 dozen eggs, regardless of the packing. The conventional 30-dozen wood case had crack openings of ½, ¾, and ⅜ in., top to bottom. The 15-dozen case, of heavy corrugated material, was also studied. Filler-flats holding 30 eggs each are frequently used as a gathering container since the eggs are positioned small end down to help maintain quality and little additional handling is required to prepare them for market. Consequently, cooling rates of uncased filler-flat stacks were determined.

Four eggs with center thermocouples were located as shown in Fig. 6, with the cooling air approaching as noted by the arrow. The eggs were cooled from a uniform mass temperature of 98-99 F with 44-45 F air. High-rate air

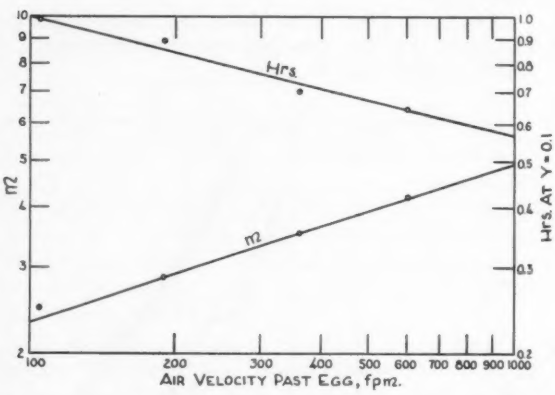


Fig. 3 Curve slopes and locations at $y=0.1$ for the air velocities of the observed data shown in Fig. 2

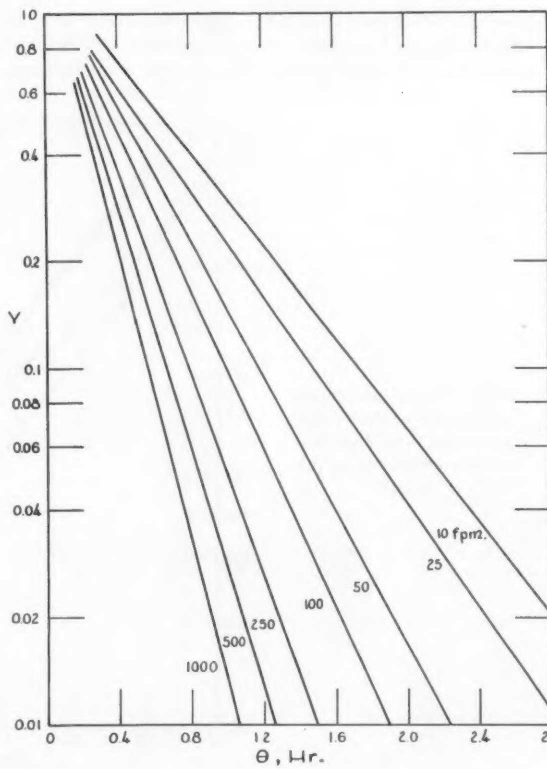


Fig. 4 Cooling times for normal sized eggs

movement was provided by a household fan; convection resulting from the ceiling refrigeration unit provided air movement for the low-rate studies. The container to be studied was located at an established point after air direction and rate (observed by a calibrated vane anemometer) at the point were recorded.

The results are presented graphically in Figs. 6 and 7. The ordinate is the difference in temperature between the center of the egg and the room. Data comparable to those of Fig. 6 were taken in each cooling study reported in Fig. 7. Only the center temperature is presented in Fig. 7, with other significant observations from each test discussed below.

The fiber case in *test 1* was impervious to air movement.

The basket in *test 2* was placed near a stack of cases where air rate was estimated at 25-30 fpm. The flow pattern was thereby changed so that tangential velocity at the approach side was 100 fpm and the opposite side 15-20 (estimated) fpm. Convection into the basket could not be measured or observed by use of smoke.

Test 3 with uncased filler-flats showed no measurable entering or discharging air.

No attempt was made to measure the air entering the case in *test 4*.

A symmetrical flow pattern was observed in *test 5*, but air movement through the mass of eggs could not be detected.

The air entering the stack in *test 6* was measured at 210 fpm.

Air entered the face of the basket in *test 7* at 230 fpm, but flow at the side and opposite faces could not be measured.

Air from the discharge face in *test 8* was 95 fpm.

(Continued on page 605)

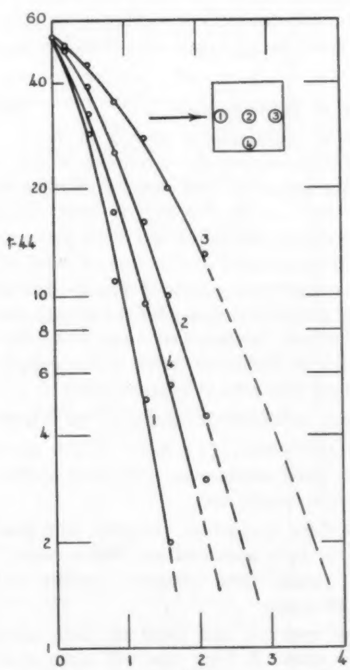
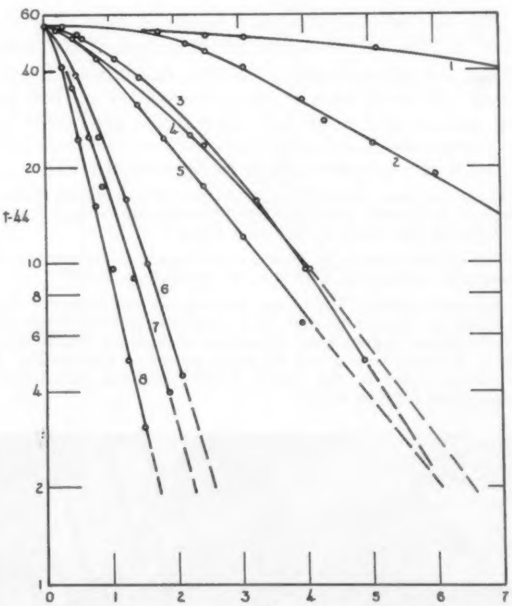


Fig. 6 Cooling data for a stack of uncased filler-flats in 570-fpm air, showing the cooling rates for the four eggs with center thermocouples

Fig. 5 Cooling rates in the above containers were observed. Filler-flats and fillers and flats are compared on the table



Curve No.	Container	Air rate, fpm
1	Filler-flats in fiber carton case	570
2	Basket	25-30
3	Uncased filler-flats	85
4	Filler-flats in wood case	570
5	Basket	85
6	Uncased filler-flats	570
7	Basket	570
8	Basket, force-ventilated in tunnel	—

Fig. 7 Cooling time for the center of the centrally located egg, No. 2 in Fig. 6, for each container, and air rate studied as noted above

Fig. 1 Furrow infiltrometer in operation

Developing

James A. Bondurant
Member ASAE

KNOWLEDGE of the rate of water infiltration into the soil has long been considered a necessity for proper design of irrigation systems. Methods of using infiltration rates in irrigation system design have been described by Parker (7)*, Israelsen (5), Lewis and Milne (6), and Hall (3).

The rate of infiltration in a furrow is most accurately determined by inflow-outflow measurements of the water flowing in a given length of furrow. A procedure for obtaining infiltration rates by the inflow-outflow method has been outlined by Criddle (2). However, a need exists for a method of obtaining infiltration data before irrigation water is available on the farm so that furrow irrigation systems can be designed without the necessity of conducting a field evaluation trial.

Cylinder infiltrometers have been used widely to obtain infiltration data for designing irrigation systems. However, the cylinder infiltrometer data have often been difficult to correlate with furrow infiltration rates (1). A correlation of basic infiltration rates obtained with cylinder infiltrometers with basic infiltration rates for furrow irrigation has been proposed by Phelan (8) for design purposes.

*Numbers in parentheses refer to the appended references.

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Acknowledgments: The furrow infiltrometer was developed during irrigation practice studies which were cooperatively supported by the Nebraska Agricultural Experiment Station, the USDA Agricultural Research Service, and the USDI Bureau of Reclamation. A preliminary report of the furrow infiltrometer was prepared by Hamilton and Bondurant (4).

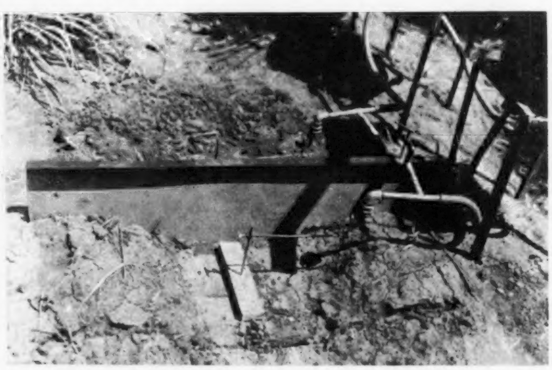

Fig. 2 Furrow infiltrometer float and float valve mechanism

Movement of Water

The movement of water from a cylinder infiltrometer may differ considerably from the pattern of water movement from a furrow during irrigation. Water movement from a cylinder is restricted to the downward direction until the water passes beyond the lower edge of the cylinder. Then it is free to flow in the direction governed by the permeability of the soil. Water in a furrow is free to flow downward and laterally in a direction perpendicular to the furrow. However, lateral flow of water parallel to the furrow is restricted by the buffering effect of the water entering the soil on both the upstream and downstream sides of a given area.

Description of Infiltrometer

The furrow infiltrometer, shown in Fig. 1, has been designed to approximate the conditions which exist in a furrow during irrigation and directly measure the rate of water infiltration in the furrow. A cross section of the furrow is isolated by the use of two metal plates. A constant water level is maintained in this furrow cross section by a float valve arrangement, shown in Fig. 2. The water level in the supply reservoir is measured at frequent intervals and the infiltration rate is computed from these data. A continuous record of the water level in the supply reservoir may be obtained with a water stage recorder.

The furrow infiltrometer consists of the following parts:

(a) Two end plates, 12 x 36 in. These are hardened, 1/16-in. sheet aluminum, reinforced at the top with 1 x 1¼-in. angle iron.

(b) Float valve mechanism, complete with float and tubing, for both measured and buffer areas. The float valve should have adequate capacity and positive shut-off action.

(c) Water reservoir and stand for both measured and buffer areas. A 5-gal. can will serve as a reservoir. The stand may be constructed of ¾-in. angle iron.

(d) A water stage recorder, if a continuous record is desired.

a Furrow Infiltrometer

A special infiltrometer has been developed to account for lateral water movement in the design of furrow irrigation systems

Procedure for Use

The furrow infiltrometer is designed to be used in the following manner:

(a) Select an area in an existing furrow or prepare a furrow-shaped cross section.

(b) Set the end plates across the furrow section at a known distance. (A one-foot cross section was used in developing the furrow infiltrometer). Drive the plates to a depth of 3 to 5 in. below the surface of the soil.

(c) Attach the float support to the end plate and center the float in the furrow. Adjust the float to give, approximately, the desired depth and width of stream in the furrow.

(d) Place and fill the water reservoirs. Adjust the water stage recorder.

(e) Prepare the buffer areas and the water supply for them.

(f) Start the infiltration test by quickly pouring water into the test section of the furrow by hand until the desired depth and width of stream is obtained. (The water should be poured onto a piece of burlap or canvas to prevent disturbing the soil.)

(g) Turn on the water supply from the reservoir and adjust the float to maintain the desired water level.

(h) Fill the buffer areas to the same depth as the measured section of furrow and adjust the floats to maintain this level. (Care should be used to prevent disturbing the soil.)

The water level in the reservoir is measured at selected time intervals and these data are converted to the infiltration rate of the soil on a volumetric basis. A nomograph, similar to Fig. 3, can be used to convert field data into infiltration data for any given furrow spacing and reservoir area. Reservoir water level records obtained with a water stage recorder are shown in Fig. 4.

As the infiltration varies with the wetted perimeter, the relative permeabilities and areas of the bottom and sides of the furrow, it is necessary to obtain the proper "stream size-wetted area" relationship when the furrow infiltrometer is used. For a furrow of given shape, this relationship is reflected in the width of stream flowing in the furrow. Analysis of stream width and furrow cross section data from irrigation studies in the Republican Valley gave the following stream size, slope and stream width relationship:

$$Y = 5.35\ X^{0.285} \qquad [1]$$

where Y is the stream width in inches and X is the stream size in gallons per minute divided by the slope in percent. The furrows were V-shaped with side slopes averaging

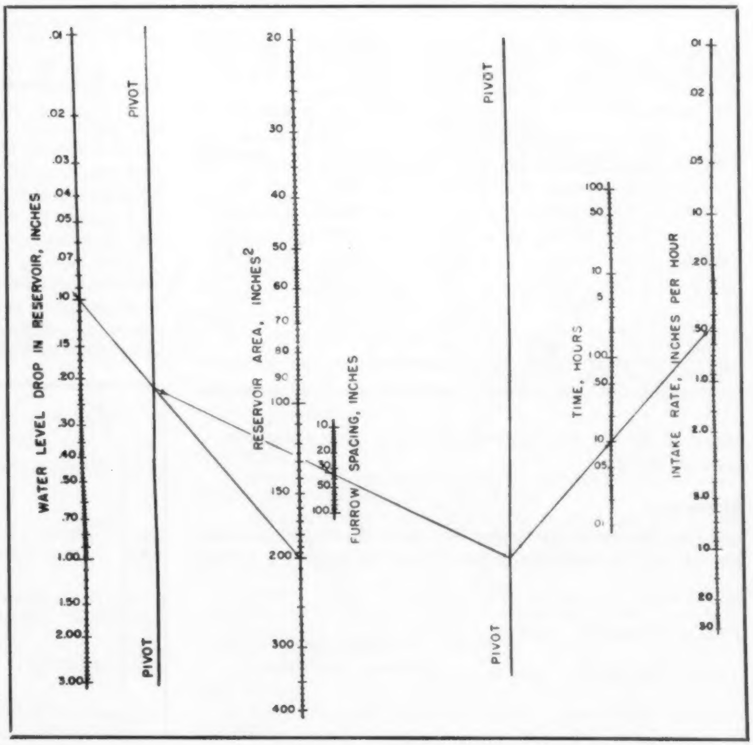

Fig. 3 Nomograph for determining infiltration rates from furrow infiltrometer data. This nomograph is based on a one-foot infiltrometer test section.

MEYERS FARM - EAST FIELD

IRRIGATION NO. 1
STREAM SIZE - 24 GPM, EAST ROW
SOIL - HALL VERY FINE SANDY LOAM
INTAKE RATE:
INITIAL - 3.37 INCHES PER HOUR
BASIC - 0.28 INCHES PER HOUR

STENSON FARM

IRRIGATION NO. 2
STREAM SIZE - 6 GPM, EAST ROW
SOIL - WAUKESHA SILT LOAM
INTAKE RATE:
INITIAL - 0.06 INCHES PER HOUR
BASIC - 0.06 INCHES PER HOUR

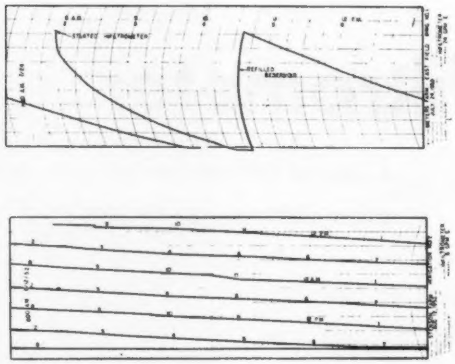

Fig. 4 (Left) Reservoir water level records obtained using the furrow infiltrometer equipped with a water stage recorder

. . . Furrow Infiltrometer

about 1 to 4. This "stream size-slope-stream width" relationship is presented in the nomograph, Fig. 5. The stream width data were taken from four row plots so that the effect of implement compaction in alterate rows would be averaged with unaffected rows. A similar relationship probably would have to be developed in other areas where the shape of furrows used is different.

Discussion

The furrow infiltrometer was tested by comparing the infiltrometer data with infiltration data obtained from field irrigation trials by using inflow-outflow measurements. Field measurements were made on four row plots which included the two furrows in which the infiltrometers were placed. Basic infiltration rates obtained by the two methods are given in Table 1. Comparison of the basic infiltration rates

TABLE 1. COMPARISON OF BASIC INFILTRATION RATES OBTAINED WITH THE FURROW INFILTROMETER AND BY FIELD TEST MEASUREMENTS

	Basic infiltration rate, inches per hour			
	1st irrigation		2nd irrigation	
Soil texture	Infiltrometer*	Field test†	Infiltrometer*	Field test†
SiC	0.08	0.07	0.07	0.12
SiL	0.29	0.28	0.10	0.22
SiL	0.12	0.16	0.09	0.12
SiL	0.37	0.16	0.18	0.14
SL	0.50	0.46	0.44	0.42
SL	0.50	0.68	0.54	0.76
SiL	0.11	0.12	0.08	0.06
SiL	0.14	0.26		

*Average of six determinations.
†40-in. row spacing. To convert to gpm/100 ft of row, multiply by 3.46.

obtained by the two methods shows a close agreement in most of the trials.

Summary

The furrow infiltrometer has been developed to simulate closely the infiltration conditions existing in a furrow during irrigation. The objective is to obtain a better measure of the infiltration rate of irrigated furrows than has been possible with previous infiltrometers. This infiltrometer provides a means of measuring furrow infiltration rates when field measurement by irrigation trial is not feasible. It should be of use to technicians and research personnel who are in need of a more accurate method of determining furrow infiltration rates for design of furrow irrigation systems.

The materials needed for constructing the furrow infiltrometer are listed and a procedure for using it is outlined. The computation of the infiltration data has been simplified by use of a nomograph.

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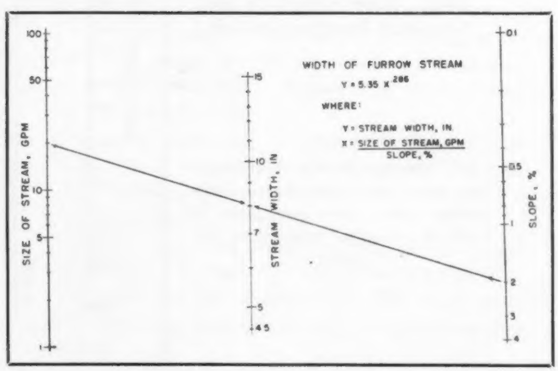

Fig. 5 Nomograph for estimating furrow stream width

. . . Shredded Silage

(Continued from page 591)

Carotene determinations had such a great amount of variation that no statement can be made as to comparisons of the carotene content of chopped and shredded silage. Statistical analysis showed no difference between treatments or storage methods.

There were differences in dry matter between treatments and storage methods. It appears that the chopped material had higher dry matter in the case of the trench silage and the lab jar silage. There was also lower dry matter in the silo jar in trench and lab jar silage for both chopped and shredded silage.

These results present a somewhat confused picture but perhaps reflect the effect of various physical treatments on some of the different factors in silage quality. The silo jar silage differed from the trench silage essentially in the manner and amount of compaction which was performed. The laboratory jar silage differed from the trench silage in temperature pattern and compaction.

Discussion and Conclusions

Differences were found between shredded and chopped silages made under laboratory conditions which indicated that shredding might be a beneficial treatment for silage. A more rapid drop in pH occurred and in some cases carotene was considerably higher in shredded silage made in laboratory jars. However, these differences did not show up in field studies. It is believed that compaction in the field, which was done with a tractor, completely obliterated any effect of surface treatment by the harvesting machine. During compaction the grass was worked and mashed until a considerable amount of free juice was present in the mass. Thus little evidence of difference due to machine treatment could be found in field scale silo work.

The work done in the two years has led to the following conclusions:

- No difference was found between chopped and shredded silage in the full scale silo for the various components (carotene, crude protein, pH and dry matter) of silage which were measured.
- Laboratory studies involving various types of laboratory containers are not adequate when manner and rate of compaction in the field is drastically different from compaction in laboratory containers, and when temperature patterns developed in laboratory containers are different from those in the field.
- In laboratory studies, shredded silage was found to have a lower pH, higher carotene content and higher levels of acetic and butyric acids than chopped silage.

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. . . Egg Cooling

(Continued from page 601)

Tests were not made with fillers and flats since each egg is isolated in a small, nominally air tight container. Cooling would be inferior to cooling in filler-flats.

The *conclusions* of the cooling studies may be summarized as follows:

Yolk and albumen retain their quality if eggs *(a)* go into cooling within 2 or 3 hr after they are laid and *(b)* are cooled to 60 F or lower in 8 or 10 hr. Consequently a cooling procedure will be satisfactory if *(a)* the above conditions are met, *(b)* the eggs are cooled soon enough to be processed and cased on an acceptable schedule, and *(c)* the refrigeration demand is not excessive.

The operator of a large enterprise, 3000 to 10,000 birds or more, will gather eggs at least twice a day—about noon and again at 4:30 pm. Those gathered at noon should be processed or ready to process by the time of the late afternoon gathering so that the precooling space will be clear for the incoming warm eggs. Thus, 4 hr would appear to be the maximum practical permissible cooling time.

A case of medium eggs (30 doz) weighs 39.4 lb. If they are cooled from 90 to 55 F, 1065 Btu will be required, and 0.022 ton of refrigeration will be needed to complete the job in 4 hr (one ton equals 12,000 Btu per hr) Note that refrigeration requirement is inverse to cooling time.

The experimental data represent normal hot summer conditions. Cooling and storage systems must of course be designed for maximum demand.

One would conclude from the above discussion that a 4-hr cooling period might be about optimum. A shorter cooling period would be advisable from the standpoint of possible egg quality and operator convenience, but would be inadvisable as regards size of refrigeration equipment and (perhaps) supplemental fan requirement for cooling.

Baskets of eggs in 85-fpm air were cooled in 4 hr to within 5 deg of the room temperature. We can conclude that baskets located in air movement somewhat above 85 fpm will cool adequately. The baskets can be placed on the floor or on shelves (narrow strips so air movement will not be restricted). In either case the air movement from the refrigeration cooler fan should be utilized most effectively. A supplemental fan may be advisable in some cases.

Filler-flat stacks of eggs cool at a slower rate than baskets. Supplemental fans will be required to cool filler-flat stacks to an acceptable temperature in 4 hr.

The approach direction of the air for cooling baskets is not important. Filler-flats must be cooled with the air approaching from the side since the bottoms are impervious to air movement.

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GOLDEN ANNIVERSARY FEATURE:

Standardization of Farm Equipment

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Fellow ASAE

RATHER than elaborate on the many benefits of standardization of farm equipment, this article is intended to chronicle the work of that capable group of engineers who have participated in the standardization activity.

The results of standardization—improved field performance, safer operation, and compatibility of implement and tractor combinations, to mention a few—speak for themselves. How did the engineers go about standardization? What was the origin of the programs they have carried out? What groups have been responsible? In addition to answering these questions, the author desires to pay special tribute to the men who spend long hours in research and in developing good practical solutions to problems, exchange technical know-how, and yet preserve the individuality of their company's product and recognize the freedom of any engineer to exercise his creative ability in the design of a still better product.

Standardization and Farm Equipment

Standards relating to farm tractor and farm implement design originate from three sources: (1) Advisory Engineering Committee of the Farm Equipment Institute, (2) American Society of Agricultural Engineers, and (3) Society of Automotive Engineers. Officially approved standards are published by the Society of Automotive Engineers in the SAE Handbook and by the American Society of Agricultural Engineers in the Agricultural Engineers Yearbook. Both publications are issued annually permitting the addition of new standards and modification of existing ones after approval by the technical groups of the two societies.

While active in the development of standards, the Advisory Engineering Committee of the Farm Equipment Institute does not publish standards but transmits its recommendations to the SAE or ASAE, or both, for approval and publication.

There is no officially or recorded field of standards activity for the three agencies, but through a process of evolution, the scope of activity now generally accepted is as follows:

Society of Automotive Engineers

- Standards relating to farm tractors and components or standards that must be coordinated with other SAE technical committees, such as the SAE Lighting Committee.
- Standards relating to other technical groups, such as tractor and implement tires, which require a joint program with the Tire and Rim Association.

American Society of Agricultural Engineers

- Standards relating to farm implements and components. Standards relating to farm implements, such as baling wire for automatic balers, have in the past originated with FEI or ASAE. Since the formation of the ASAE Power and Machinery Technical Committee, standards of this nature are referred to and developed by the Committee.

Advisory Engineering Committee, Farm Equipment Institute

- Standardization necessary to promote interchangeability between implements produced by one manufacturer and tractors of different makes and models, to insure that the combination of implement and tractor will provide mechanical compatibility, safe operation and proper functional performance in the field.
- Standards deemed necessary primarily to promote safer operation of farm implements and tractors.
- Activity pertaining to the International Organization for Standardization (ISO). Delegates from the FEI Advisory Engineering Committee represent the American Standards Association on two ISO committees: TC 22T (Farm Tractors) and TC 23 (Agricultural Machines).

Origin of Standardization Projects

Standardization projects, or requests for standardization, originate from many sources. Requests are received from farm organizations, the U.S. Department of Agriculture, or from manufacturers desiring to develop a line of products better suited to agricultural requirements. Some programs originate purely to reduce the variety of components required to service the industry, thus improving availability and effecting economies for the user.

One of the principal originating sources is within the industry, among design engineers who recognize benefits of improved design, better performance and elimination of excess variety to be obtained through some form of standardization. Farm equipment engineers take justifiable pride in forecasting the need for new standards or modification of existing ones due to progress in design or changing agricultural practices. In many cases new standards are created or existing ones altered well in advance of the introduction of the equipment to the farmer.

Membership and Operating Procedure

Since this paper is limited to a discussion of standardization as related to farm equipment, reference will be made only to that segment of the technical organization of SAE-ASAE activity involved. It should be recognized, for instance, that SAE maintains a well-trained, highly skilled technical staff, assisting in and serving the various activities relating to the automotive and aeronautical as well as farm tractor fields.

The ASAE also provides technical groups carrying on similar activity in the farm structures, rural electrification,

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Paper prepared expressly for a Golden Anniversary feature.

The author—E. W. TANQUARY—is staff engineer, farm implement div., International Harvester Co., Chicago, Ill.

and soil and water divisions. The FEI Fasteners Committee likewise is active in the promotion of standardization of hardware and collateral items not involving equipment design. The FEI Sprayer and Duster Committee is active in standardization and research projects relating to agriculture.

Society of Automotive Engineers

Responsibility for this society's technical activity rests with the SAE technical board. Members of the board are each appointed by the national president to a 3-year term. All technical activity of SAE is directed and supervised by the technical board, each segment of which has a representative on the board. Appointments are made on an individual basis, not as a representative from an individual company. Selection is on the basis of being qualified from the standpoint of ability, experience and over-all knowledge of the particular field an individual is chosen to represent.

The technical board approves all new or revised standards and recommendations before publication in the SAE Handbook. All requests or suggestions for development of a standard are presented to and studied by the technical board. Requests usually originate through the industry or from a military agency of the federal government. Such requests are carefully scrutinized to ascertain the actual benefit of the standard proposed, if desired by the industry in general, and if the objective as set forth in the proposal will avoid standardization of design that might limit further development.

After final approval, the project is then assigned to the proper technical group. Projects relating to farm tractors are assigned to the Tractor Technical Committee. Membership of TTC is selected solely on the basis of technical competence. In the interest of obtaining a broad background and knowledge of tractor engineering, an effort is made to appoint engineers from all phases of the tractor engineering field. The chairman and vice-chairman are selected from the membership to serve a one-year term.

Projects assigned to TTC by the technical board or those originating within the committee are then, after approval, assigned to a sponsor appointed by the chairman. The sponsor then organizes a subcommittee for the project, serving as the chairman and securing qualified representatives from companies interested in the project.

The subcommittee then acts as an independent group, making the necessary contacts with other technical groups or engineers best qualified to contribute to the project. They may carry out actual development, test work as a committee, or enter into a joint project with another agency—whatever is needed to develop their recommendations.

The chairman of the subcommittee of the project makes a progress report to the TTC at each of its sessions.

Recommendation of the subcommittee, if in the form of an existing one, is submitted to TTC for approval. After final approval by TTC, the proposed standard is then referred to SAE headquarters for submission to members of the technical board. Submission to the board is usually made by letter accompanied by a ballot for approval. Board members then ballot approval.

In case of disapproval, a letter stating the reasons, and a proposal are referred back to TTC or the subcommittee for further consideration. After final approval by the technical board, the approved standard is prepared for publication in the next issue of the SAE Handbook.

American Society of Agricultural Engineers

Final responsibility for approval of the society technical activity lies with the Council. The Council has, however, delegated most of the technical program responsibilty to technical committees of the respective divisions.

Industry members of the technical committee of the Power and Machinery Division are appointed by industry manufacturers. Additional members are appointed to represent public-service agencies. Any interested company, large or small, is encouraged to request representation on the committee.

The combination of engineers from industry and public-service agencies provides a sound technical organization, with facilities for research or field test and the latest information pertaining to new or changing agricultural practices. The chairman and vice-chairman are elected from the committee membership to serve a three-year term.

Projects originating within the committee, or referred to them, are carefully screened to determine actual benefit of a proposed standard, interest on the part of manufacturers, and if a standard as outlined would be practical without limiting further development.

Accepted projects are then assigned to a subcommittee composed of engineers qualified and in position to contribute to the project. The chairman is appointed by the chairman of the technical committee and, in turn, selects membership of his group from engineers most familiar with the project. Chairmen of the subcommittees report to the technical committee as to progress and for guidance or assisance in carrying out their assignments.

Proposals for new standards or modification to existing ones are submitted to the technical committee for approval. Submission of the technical committee and subsequent action is usually made by ballot, with a review and recorded approval of letter ballot. Action at the semiannual meeting of the technical committee on new standards is submitted to the Council as a matter of information.

Final approval by the technical committee on any action pertaining to a new or existing standard carries authorization for publication in Agricultural Engineers Yearbook.

FEI Engineering Committee

Membership on the FEI Advisory Engineering Committee is appointed by member companies of the Farm Equipment Institute. Full-line manufacturers appoint two representatives—one tractor and one implement engineer. Manufacturers of tractors only or implements only supply one representative.

Appointments are made on the basis of chief engineer or executive capacity, thus providing a working committee empowered to speak for their respective companies and to implement test or development programs. There is no specified term of service, members serving until replacement is made by their respective companies.

Due to organizational changes, new members are appointed while some of the original membership are still serving on the Committee. The combination of new appointees with a fresh viewpoint working together with representatives having years of experience in farm equipment design provides a proper balance of technical ability, tempered with field experience, that is extremely valuable in arriving at sound, practical solutions of problems before the Committee.

The chairman of the Advisory Engineering Committee is elected from the committee membership with no specified term of office.

Committee members are encouraged to bring other engineers from their company qualified to participate in discussions relating to certain equipment or special problems. However, only official company representatives or their designated substitutes are eligible to vote.

Subcommittees are established to develop specific projects. Subcommittee chairmen are appointed by the general chairman and are selected primarily on the basis of ability and knowledge of the project, although efforts are made to distribute chairmen of subcommittees between interested companies so as not to burden any one company.

Membership of a subcommittee is developed by the subcommittee chairman and general chairman of the Committee requesting each company to designate an engineer best qualified to contribute to the committee activity. The chairman or other member of a subcommittee need not be an official member of the Advisory Engineering Committee. A subcommittee is encouraged to invite outside manufacturers, who are in position to contribute to the activity, to attend its meetings.

Recommendations of a subcommittee are reported to the Advisory Engineering Committee for consideration for final action. Action by the subcommittee is not necessarily unanimous although attempts are made to resolve all differences before finalizing recommendations.

Proposals for new standards or revisions of existing standards are presented to the Advisory Engineering Committee, and, after consideration by that group, official action is taken to submit the proposal to the SAE or ASAE, or to both, for adoption. Any manufacturer, including a member company of the FEI, is thus free to adopt the standard or not, as it sees fit.

Some standards projects, involving both tractors and implements, require a certain degree of coordination to assure a customer purchasing a tractor and implement of different makes that he will receive a compatible combination. In some cases a target or objective date for the change is established by members of the Advisory Engineering Committee.

Establishment of the target date may require polling Committee members to determine the approximate date their respective companies will be in position to comply with the new specification, but the answers do not constitute a commitment that their company will adopt the standard or will definitely supply the equipment on that date. Individual companies may vary the production date over a period of months and use the target date only as a basis of setting up their own compliance programs.

Since activity of the Committee involves actual design in many cases, engineers presenting new ideas of patentable nature for its consideration are obligated to advise the group of the patent status, stating the idea will not be patented, or if a patent application is to be filed, his company will grant a free license under the patent or/and will or will not make the idea available to other companies under a license agreement.

No fixed rules are followed as to the scope of standardization projects handled by the Committee. Through the process of evolution certain basic principles have governed the activities of the Committee, as follows: (1) A standard should not in any way restrict or limit the creative ability of an individual engineer or manufacturer. (2) Standards affecting design should be limited only to the dimensions and specifications actually necessary to achieve the objective of mechanical interchangeability and functional performance. Material heat-treatment and other factors affecting manufacturing processes should be left to the discretion of the individual company. (3) the Committee incorporates in the standard or recommendation information of an explanatory and informative nature they feel will be of value to young engineers and engineers applying the standard who are not familiar with the background explored during its development. (4) Standardization projects have been confined to tractor and implement components as required to promote interchangeability between farm tractors and trailing implements of different makes and models.

No attempts have been made toward standardization of mounted equipment. It has been the opinion of the Committee that mounted equipment is necessarily integrated with the type of hydraulic system used and with the basic design of a particular tractor. Standardization in this important field of development is considered premature and no specification should be established that would tend to limit the ability of any engineer or manufacturer to produce a new tractor and implement combination of benefit to agriculture in general.

The FEI Advisory Engineering Committee was originally established to implement recommendations of the FEI Safety Committee. Farm safety remains one of the primary functions of the Committee and plays an important part in the development of any standard. Ideas which contribute to safer operation of farm equipment are customarily made available to other companies free of charge, even though a patent application may be made to provide recognition for the inventor.

Proposals developed for recommendation to the International Organization for Standardization (150). Subcommittees have been established to consider standardization proposals advanced by ISO/TC 22T (tractors) and ISO/TC 23 (agricultural machinery), and to establish tentative proposals that would be practical and acceptable to the American farm equipment industry. The FEI Engineering Committee has ISO subcommittees active at the present time on mowers, disks, 3-point hitch, and sprayer nozzles, and the Committee maintains close liaison with the SAE Agricultural Wheel-Type Tractor Test Code Subcommittee to insure proper consideration of the American tractor test procedure in the development of an ISO international farm tractor test code.

Due to the difficulty in securing replacement parts in foreign countries, particularly in remote areas, the interchangeability of certain wearing parts, such as mower knife sections and guards, is highly desirable and would be of real benefit to users. Standards that would assure adequate field performance of tractor and trailing implement combinations would also benefit user, particularly in those countries importing farm equipment.

These factors are recognized by the FEI Engineering Committee which has a genuine willingness to cooperate with the ISO committees in the development of sound, practical standards and to contribute the essence of their experience and know-how to assist the engineers in other countries.

The FEI-ISO subcommittees and standardization sub-

committees of American technical societies have maintained the same basic principles in development of their recommendations for consideration as ISO standards. These principles include only the specifications required for mechanical interchangeability and field performance. They do not include specifications to cover other than minimum quality, or specifications that would constitute the basis of an acceptance standard as to quality or design. The specifications are such that any manufacturer may exercise initiative as to material, manufacturing process or design to produce a superior product that will enhance the company's participation in the market and provide a better product for the consumer.

Close cooperation is maintained with the Canadian Standards Association, and an exchange of information relative to standardization activity is maintained with the British Standards Institution.

Activity of the FEI-ISO subcommittees is, at present, confined to the development of American proposals for consideration by the ISO technical committees, TC 22T and TC 23, in conjunction with proposals made by other countries. Action on recommendation of the FEI-ISO subcommittees is on the basis of developing proposals acceptable to the American farm equipment industry for submission to the ISO and is a basic guide to the FEI engineering committee representatives serving the American Standards Assoication as an official delegate attending technical sessions of TC 22T and TC 23. The most recent official meeting of these two committees was held in Lisbon, Portugal, May 6 to 14, 1957.

It is difficult to assess the value of ISO standardization activity as related to the sale of farm equipment in this country at the present time. Proposals developed by the FEI-ISO subcommittees are primarily considered for application to equipment exported or manufactured for foreign sale and would necessarily be referred to the FEI Committee for approval and their recommendation for submission to ASAE or SAE for adoption as a society standard.

International Organization for Standardization (ISO)

In 1944 the United Nations started a committee identified as the United Nations Standards Coordinating Committee (UNSCA) which in 1946 was reorganized as the International Organization for Standardization (ISO).

Objectives of ISO are defined as "promoting the development of standards in the world with a view to facilitating international exchange of goods and services and development of mutual cooperation in the sphere of intellectual, scientific, technological and economic activity."

Membership of the ISO is by national standards institutions of, at present, 39 countries. The American Standards Association is the official member from the United States to the ISO and as such may attend the meetings and be recognized by the ISO as such an institution. It is important to note that ASA is the only recognized standards organization from the United States.

Standardization activity is conducted by technical committees assigned to a specific subject, as in the instance of TC 22T (Tractors) and TC 23 (Agricultural Machinery).

Technical committee activity is channeled through a secretariat also acting as chairman at committee sessions, this task being entrusted to a member state or member institution.

The Secretariat for ISO TC 22T (Tractors) has been assumed by Francaise de Normalisation (AFNOR), located in Paris, France, J. Birle, director general, acting as chairman of the committee.

The Secretariat of ISO TC 23 (Agricultural Machinery) has been assumed by Reparticao do Normalizacao, M. Fausto Carriera, inspector general, acting as chairman of this committee.

To facilitate development of the standards proposals, a procedure has been established whereby technical phases of the work are handled by a subcommittee of the ISO technical committee, identified as an ISO working group. Recommendations of a working group are presented to the proper technical committee for consideration as a draft proposal." When a draft proposal concerning one or more phases of a standard under consideration is approved by a majority of the ISO technical committee members it becomes an ISO Resolution.

ISO resolutions are sent to members of the technical committees for approval. Members are allowed two months for reply. Absence of reply within the stipulated reply date is assumed to be an agreement with the resolution. When a resolution is approved by a majority of the technical committee members it becomes a "Draft ISO Recommendation."

The draft ISO recommendation is submitted to all ISO member nations and a majority approval raises the draft recommendation to the status of "ISO Recommendation."

Should no member body make an objection to the proposal to transform an ISO recommendation into an ISO standard, the recommendation becomes an ISO standard. Only one negative vote is required to prevent adoption of a recommendation as an ISO standard. In the event one or more negative votes are received, the proposal remains an ISO Recommendation for a full two-year period, during which time efforts may be made to resolve the basis for disapproval.

Following expiration of the two-year period the ISO recommendation is again submitted to member bodies for approval. Should one or more negative votes again be registered the recommendation does not became an ISO standard and must remain as an ISO recommendation.

Machine Bolt and Capscrew Functions

THE function of a machine bolt is the same as that of a capscrew, even though they vary markedly in their application, according to Russell, Burdsall & Ward, fastener technicians.

A machine bolt at one time was known as a rough product because it was produced by hot-forging; a capscrew was regarded as a finished product because it was made on a screw machine. As the bolt-making process developed, both products came to be produced on cold-upsetting machines.

Capscrews are used in products requiring either higher quality or more finished appearance than machine bolts. They are held to closer tolerances, are given a semi-finished bearing surface, and are machine-pointed.

Capscrews are carried in distributor stock with hex head and without nuts. They are furnished both bright and heat-treated in either coarse or fine thread. Machine bolts are carried in distributor stocks with square heads and square or hexagon nuts, in coarse thread only. They are made and stocked over a much wider range of diameters and lengths than cap screws.

Photo High Lights of

The entrance into a darkened dining hall of a huge birthday cake decked with 50 candles was a fitting finale to a dramatic pageant during the annual banquet. Retiring President Roy Bainer is shown cutting the first piece

GOLD MEDALISTS

Presentation of Gold Medals was made during the annual banquet by Retiring President Roy Bainer. At left Archie A. Stone receives the John Deere Medal; at right Rudolph H. Driftmier, the Cyrus Hall McCormick Medal

CHARTER MEMBERS

Charter members on hand were Charles A. Ocock *(left)* and Howard W. Riley. Mr. Riley gave a brief report during the banquet program of the first meeting of the Society 50 years ago.

Arthur S. Flemming, *(center)* president of Ohio Wesleyan University and formerly Director of Defense Mobilization, addressed the general session on the subject of the nation's interest in scientists and engineers, Tuesday morning, June 25. *(Left to right)* A. W. Farrall, chairman of local arrangements committee; Harold E. Pinches, assistant to administrator, Production Research, ARS, USDA; Flemming; Roy Bainer, president of ASAE; and Walter M. Carleton, program chairman

PAST - PRESIDENTS

Past-presidents in attendance at the meeting. Seated (left to right) Roy Bainer, 1956-57; S. P. Lyle, 1938-39; W. G. Kaiser, 1929-30; E. E. Brackett, 1940-41; C. A. Ocock, 1911; H. W. Riley, 1912; H. H. Musselman, 1915; Raymond Olney, 1919. Standing (left to right) W. H. Worthington, 1955-56; E. W. Tanquary, 1953-54; M. L. Nichols, 1946-47; J. D. Long, 1945-46; G. W. McCuen, 1934-35; R. H. Driftmier, 1944-45; A. J. Schwantes, 1948-49; F. J. Zink, 1949-50; O. W. Sjogren, 1926-27; E. W. Lehmann, 1923

Golden Anniversary Meeting

East Lansing, Michigan

June 23 to 27, 1957

The Pacific Coast Section used a most effective way in which to publicize the 51st Annual Meeting to be held on the Santa Barbara Campus, University of California, June, 1958. A beautiful co-ed in a "cigarette girl" costume attended many functions and passed out samples of California food products and travel folders. O. W. Sjogren *(Center)*, a California resident, checks to see that Truman E. Hienton, head, farm electrification section, AERD, ARS, USDA, Beltsville, Md., receives sufficient travel material

(Left) The ladies luncheon and bridge party, held Tuesday, June 25, at the MSU student union, was well attended

STUDENT ACTIVITIES

(Below) Incoming President Earl D. Anderson chats with Student Paper Award winners *(left to right)* Irwin A. Eickmeyer, University of Illinois; Carl T. Morton, Michigan State University; and Wayne Clyma, Oklahoma A and M College. Eickmeyer was selected to present his paper before the annual business meeting

L. H. Skromme, chief engineer, New Holland Machine Co. *(left)* spoke on "Your Future in the Farm Equipment Industry" during the student dinner, Tuesday evening, June 25, sponsored by the Farm Equipment Institute. *(Right)* R. S. Stevenson, president of Allis-Chalmers Mfg. Co. and chairman of the FEI executive committee, poses with FEI Trophy Award winners Joseph G. Long, University of Georgia (Class A winner) and Kermit O. Allard, University of Maine (Class B winner)

Nominations for 1958 ASAE Gold Medal Awards

In accord with the rules governing the award of the John Deere and Cyrus Hall McCormick Gold Medals, the Jury of Awards of the American Society of Agricultural Engineers will receive from members of the Society, up to November 1, nominations of candidates for the 1958 awards of these two medals.

The Jury of Awards desires that members of the Society consider it their duty and obligation to give serious thought to the matter and nominate for either or each of these awards the men they believe to be most worthy of the honor. Each nomination must be accompanied by a statement of the reason for nominating a candidate and qualifications of the nominee, including his training, experience, contributions to the field of agriculture, a bibliography of his published writings, and any further information which might be useful to the Jury in its deliberations.

The Jury will consider nominations received on or before November 1, and these nominations should be addressed directly to the Secretary of the Society at St. Joseph, Michigan. The Secretary will supply on request a standard set of instructions for preparing information in support of nominees for the Society's gold medal awards; in fact, it is important that these instructions be followed in preparing material on behalf of any nominee.

Cotton Gin Engineers to Take Agricultural Engineering

The National Cotton Council will sponsor a cotton gin engineering curriculum at Clemson Agricultural College, Clemson, S. C., and Texas Technological College, Lubbock, Texas, starting in September. Basic qualifications decided on by the Council were that the cotton gin engineers trained by the colleges should take the agricultural engineering curriculum and some specializing courses to qualify them as ginning specialists. This program is said to be the first of its kind in the United States.

Graduates in gin engineering will supply an increasisng demand for college-trained men by state and federal extension service, USDA ginning laboratories, gin machinery manufacturers and commercial gins, it is said. Members of the National Cotton Council estimate that 10 or 12 graduates per year could be absorbed by the cotton industry as a whole for many years to come.

LPI Curriculum Recognized

The course content committee of the Education and Research Division of ASAE, C. G. E. Downing, chairman, has announced that the curriculum of the agricultural engineering dept. at the Louisiana Polytechnic Institute is now recognized by ASAE. The institution will be included on future lists of "recognized professional curriculums in agricultural engineering" that are distributed from ASAE headquarters.

Mrs. Ivan D. Wood Killed in Automobile Accident

As this issue was going to press, word was received that Mrs. Ivan D. Wood, wife of Dr. Ivan D. Wood, ASAE past-president, was killed in an automobile accident in Denver on the evening of July 26. Both Dr. Wood and daughter, Barbara, were hospitalized as a result of the accident. Funeral services for Mrs. Wood were held at Cozad, Nebr., on July 31.

ASAE MEETINGS CALENDAR

August 27, 28 and 29 — North Atlantic Section, University of Delaware, Newark

October 23-27 — Pacific Northwest Section, Compton Union Bldg., State College of Washington, Pullman

November 8-9 — Ohio Section, University of Ohio, Columbus

November 15 - 16 — Virginia Section, Blacksburg.

December 15-18—Winter Meeting, Edgewater Beach Hotel, Chicago, Ill.

June 22-25 — 51st Annual Meeting, Santa Barbara Campus, University of California, Santa Barbara, Calif.

Note: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

University of Arizona to Offer AE Degree

K. R. Frost, acting head, agricultural engineering department, University of Arizona, has announced that a professional curriculum in agricultural engineering will begin with the fall semester, 1957. A four-year degree will be given by the college of engineering and the course is being set up to meet requirements for approval as an accredited curriculum by the Engineers' Council for Professional Development. A degree in farm mechanization, given by the college of agriculture, will continue to be offered.

Southern AE & VA Ass'n. Elects New Officers

The annual meeting of the Southern Association of Agricultural Engineering and Vocational Agriculture was held April 1 at the Dinkler Plaza Hotel in Atlanta, Ga. The following officers were elected for the new year: President, J. Bryant Kirkland, North Carolina State College; vice-president, Earl T. Swink, Virginia Polytechnic Institute; secretary, A. W. Snell, Clemson Agriculture College; and fiscal officer, George W. Weigers, University of Tennessee.

(News continued on page 626)

NECROLOGY

Harry B. Walker, Honorary Member and Past-President of ASAE, died after a prolonged illness at his home in Davis, Calif., July 27.

Dr. Walker had been an active member of ASAE since 1921. He was a Life Fellow and just recently was elected Honorary Member. As a vice-president of the Society, he served as acting president during the year 1924-25 following the death of F. W. Ives. Later, in 1942-43, he was elected and served as president. He also served on the Council and as chairman of the College Division. In 1939 he was awarded the John Deere Gold Medal, the second recipient of this award.


Harry B. Walker

He was born in 1884 near Macomb, Ill. His early education was in the rural schools and in the apprenticeship of working as a farm hand. Never attending high school, he made up its lack by working his way, after he was nineteen, in a private school at Macomb, Ill., followed by preparatory work at Highland Park College in Des Moines, Iowa. While there he visited Iowa State College at Ames, and decided to become a civil engineer. In 1906 he entered Ames as a subfreshman working to earn his way. He graduated in 1910 with a B.S. degree in civil engineering, and earned a professional degree in 1920.

Seventeen years of his professional life were spent at Kansas State Agricultural College where he organized the agricultural engineering department and became its first chairman. In 1928 he joined the faculty of the University of California and became head of the agricultural engineering department. He retired in 1950, and in 1954 the University of California conferred a Doctor of Laws upon him for distinguished service in the field of agricultural engineering.

A more complete biography of Dr. Walker appears on page 280 in the May, 1957, issue in which the announcement of his Honorary Membership was made.

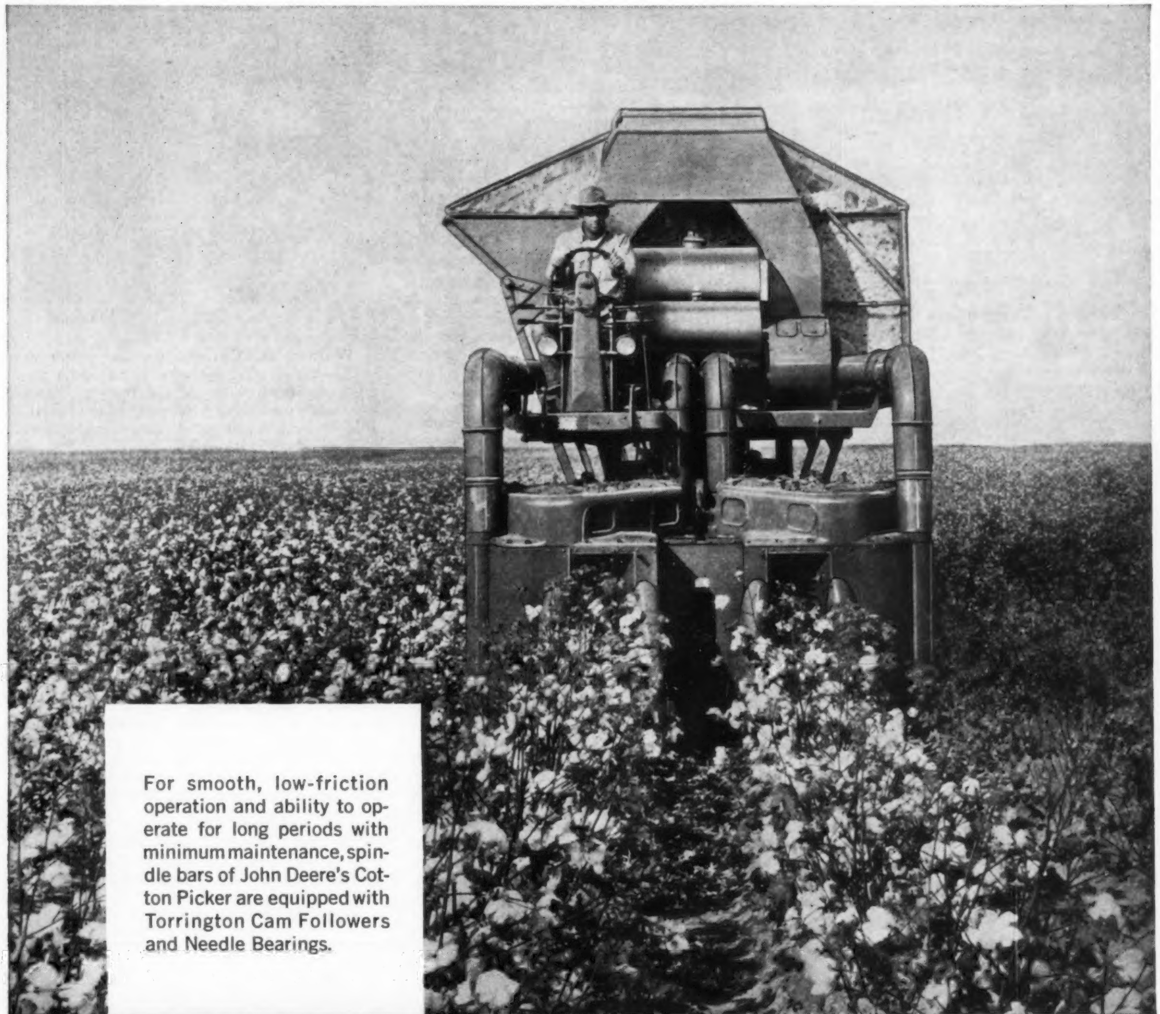
EVENTS CALENDAR

August 28-31 — *Soil Conservation Society of America,* Asilomar Beach State Park, Pacific Grove, Calif. For more information write to H. Wayne Pritchard, Executive Secretary, 838 5th Ave., Des Moines 14, Iowa.

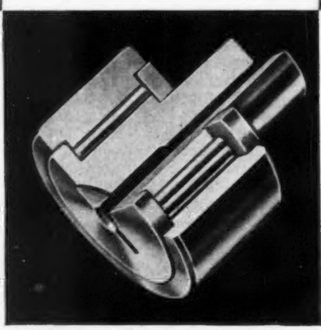
August 29 — *Joint Committee on Grassland Farming,* Stanford University, Palo Alto, Calif. A field bus tour is scheduled for August 30.

September 23-25 — Sixth annual meeting of the *Standards Engineers Society,* Hotel Commodore, New York, N. Y. For more complete information write to Herbert G. Arlt, Bell Telephone Laboratories, Murray Hill, N. J.

September 23-25 — Twelfth annual conference of the *Petroleum Division of The American Society of Mechanical Engineers* will be held at the Hotel Mayo in Tulsa, Okla. Problems of the petroleum industry will be discussed by engineers representing all branches of operations.



For smooth, low-friction operation and ability to operate for long periods with minimum maintenance, spindle bars of John Deere's Cotton Picker are equipped with Torrington Cam Followers and Needle Bearings.



1120 "FINGERS" mechanized to pick cotton

Today, modern farm operations are mechanized with production-boosting machines like the John Deere No. 8 Two-Row Cotton Picker.

In this cotton-harvesting wonder, the picking unit consists of 56 spindle bars each with 20 barbed spindles. The bars are actuated by Torrington Cam Followers and their drive shafts are equipped with Torrington Needle Bearings. These high-capacity, efficient anti-friction units help keep the mechanical fingers operating smoothly for long periods with minimum maintenance.

The Torrington Company pioneered the development of Needle Bearings and has worked with farm equipment designers in countless successful applications. Whatever your bearing needs might be, for engineering service or assistance with application problems, talk to your Torrington representative. *The Torrington Company*, Torrington, Conn.—and South Bend 21, Ind.

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John D. Cowsar has been transferred from district manager for the American Coin Meter Corp., in Colorado Springs, Colo., to western division manager, with headquarters in Dallas, Texas.

Galen F. Watts has accepted a position in the implement product planning dept. of the Tractor and Implement Division of Ford Motor Company in Birmingham, Mich. Previously he was regional service supervisor for the Ferguson Division of Massey-Harris-Ferguson, Inc. in Kansas City, Kans.

Errol Rodda is now living in Johannesburg, South Africa, where he is field engineer for Caterpillar Tractor Co.

James H. Anderson has returned to the position of associate agricultural engineer in the agricultural engineering dept. at Clemson Agricultural College, Clemson, S. C. He will be engaged in teaching and research in the field of power and machinery. He received a Ph.D. degree from Iowa State College in March.

F. E. Rowland has been appointed chairman of the agricultural department of General Electric Co. Ltd., London, England. This appointment came after his company acquired a share interest in the Simplex Dairy Equipment Co. Ltd., and its associated company, Agricultural Supplies Ltd., Cambridge.

John J. McDow, head of the agricultural engineering dept., Louisiana Polytechnic Institute, has been awarded an Advanced Graduate Study Grant by the Southern Fellowships Fund to continue graduate study at Michigan State University during the period June through December, 1957. The Council of Southern Universities set up these awards for the purpose of encouraging college teachers to undertake advanced graduate study.

Carl W. Hall, professor of agricultural engineering, Michigan State University, is on a leave of absence for two months and is working as a research consultant for the University of Puerto Rico with special emphasis on engineering problems related to agriculture.

David H. Huntington, associate professor of agricultural engineering, University of Maine, Orono, has been promoted to the position of assistant to the dean of the college of agriculture. His primary responsibility will be to direct the two year agricultural program of instruction at the University.

Henry A. Parker has been appointed as sales manager of the Utica branch of the Oliver Corp., with general supervisory responsibility. He was formerly territory manager of the South Bend, Ind., branch and has been on leave while attending the University of Indiana, from which he recently received a master's degree in business administration.

William D. Churchill has accepted employment with the Corps of Engineers, U.S. Army, in Omaha, Nebr. He was formerly field man with Cargill Inc. of Aurora, Nebr.

Robert H. Stasell has been promoted to manager of the Retread Development Div. of Firestone Tire & Rubber Co., Akron, Ohio. Formerly, he was tire design engineer for the company.


W. A. CUTLER


C. A. JOHNSON

Willard A. Cutler, drainage engineer of Michigan State University, has been appointed senior editor of the Buckeye Farm Drainage News, a new publication available free to farmers, drainage contractors and soil conservation officials.

Curtis A. Johnson has joined the staff of the University of Massachusetts, Amherst, as associate professor of agricultural engineering extension. For the past two years he has been serving with ICA in Pakistan. Prior to that he was on the staff at Iowa State College for five years. His new position was created by the retirement last year of W. C. Harrington.

Robert S. Calkins has resigned from the position of design engineer in the Upper Darby, Pennsylvania Engineering and Watershed Planning Unit of SCS, to accept employment as materials engineer in the Soil Mechanics Laboratory of the SCS in Lincoln, Nebr. This assignment deals mostly in the interpretation of laboratory tests on soils for design and construction purposes.

J. J. Paterson has accepted a position on the staff, college of agriculture, Southern Illinois University, Carbondale. Formerly he was associate professor and acting chairman of agricultural engineering at the University of Manitoba, Winnipeg, Canada.

Iowa Section

Seventy-five members and guests attended the first meeting of the newly organized Iowa Section, June 7, in Des Moines, Iowa. By-laws for the new section were read and approved, and the following officers were elected for the coming year: Chairman, Leonard F. Janssen; vice-chairman, Harold E. deBuhr, Edward C. Ryan, Dale L. Woolsoncroft; and secretary-treasurer, Francis E. Schlueter.

After the business meeting a program was presented by John W. Gibb, sales manager, C. A. Roberts Co. Films on welded and seamless tubing were shown and a short discussion followed.

Georgia Section

The following officers were elected for the year 1957-58 at a meeting of the Georgia Section, May 10-11: Chairman, Graham Daniels; vice-chairman, Gordon Futral; and secretary-treasurer, Paul Crawford.

Virginia Section

The Virginia Section will hold a meeting in Blacksburg, November 15-16. An all-day meeting will be held on Friday, November 15, with a banquet scheduled for the evening. Saturday morning will be devoted to a business session.

Ohio Section

The Ohio Section meeting will be held November 8-9 at the Ohio State University, Columbus. The general theme of the meeting will be on problems in the harvesting and storage of forage crops. The tentative program lists topics on analysis of problems of various methods of harvesting forage crops, problems in the design and operation of forage harvesting machinery, innovations in forage harvesting, problems inherent in the handling of forage crops, a progress report on activities of the agricultural engineering dept. of OSU, and problems involved in hay and silage storage.

A banquet is scheduled for Friday evening, November 8, and a football game between OSU and Purdue will be played Saturday afternoon.

(Continued on page 632)


Officers elected during organizational meeting of the newly formed Iowa Section. *(Left to right)* Kenneth K. Barnes, acting chairman; Leonard F. Janssen, chairman; Harold E. deBuhr, first vice-chairman; Edward C. Ryan, 2nd vice-chairman; Francis E. Schlueter, secretary-treasurer; and Dale L. Woolsoncroft, 3rd vice-chairman

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AGRICULTURAL MACHINERY NEWS

LATEST PROPERTY AND APPLICATION DATA ON

ZYTEL® nylon resin

Easily molded ZYTEL® nylon resin is used to make strong, shock-resistant machine parts

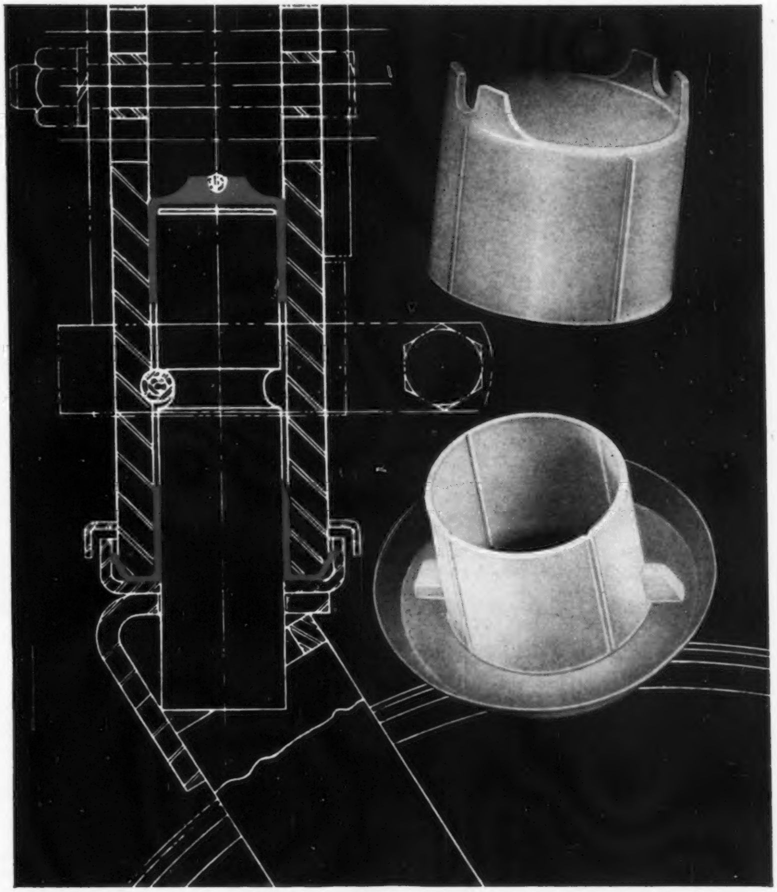
Bushings of ZYTEL in wheel assembly of Ford hayrake resist wear, keep out dust

These two intricately shaped, close-tolerance bushings, for use in heavy-duty wheel spindles, are produced by injection-molding ZYTEL nylon resin. Combining any other method with any other material would have been more costly. Here, the use of bushings of ZYTEL simplified design with a gain in over-all properties and no loss in strength.

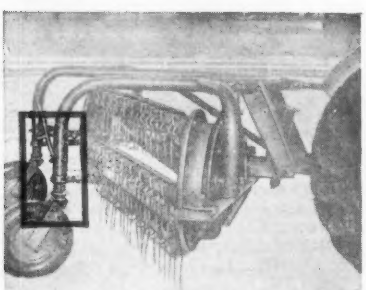
Components of ZYTEL are very strong, even when thin-walled. They can be molded with great accuracy—for example, the four semicircular lubrication grooves inside each bushing have a .03" radius, and the bushings may be installed with no further surface finishing.

ZYTEL has a low specific gravity (1.14), with the highest strength-to-weight ratio of any resin. It often outperforms heavy metal parts. For instance, both gears and sleeve bearings of ZYTEL, tested in the presence of abrasive materials such as sand, outwear metal components by far. The load-carrying ability and temperature range of ZYTEL are approximately those of babbitt, with considerably better abrasion resistance. Bearings of ZYTEL are resistant to pound-out. Under light loads, they need little or no lubrication. Operating with lubricant, simple sleeve bearings can support loads up to 1,000 lbs. per sq. in. at rubbing velocities up to 500 ft. per min.

For engineering data and more design ideas using Du Pont ZYTEL nylon resin, send us the coupon.



BUSHINGS of ZYTEL in gauge wheel spindles of side delivery rake have high strength and wear resistance. Lower bushing also functions as thrust bearing and dust seal. The two gauge wheels are full-castering and carry entire weight of the rake. (Hayrake is manufactured by the Tractor and Implement Division of the Ford Motor Company, Birmingham, Michigan.)



SEND FOR INFORMATION

For additional property and application data on Du Pont ZYTEL nylon resin, clip and mail this coupon.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept.
Room 18, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont ZYTEL nylon resin. I am interested in evaluating this material for________

Name________

Company________ Position________

Street________

City________ State________

Type of Business________

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660 Montreal Quebec

"Hay in a Day" System

New Holland Machine Co. has announced a new system of haymaking called "hay in a day." This method uses a team of machines which helps the farmer cut part of his crop each day and get it under cover before nightfall; into storage in 24 hours under favorable conditions.

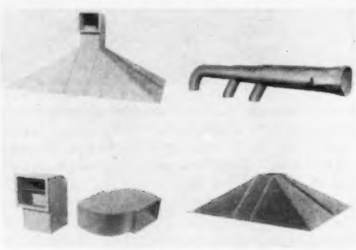
The first operation in the system is done by a mower-crusher that mows and crushes hay in a single operation. This machine has

smooth crushing rolls that crack stems lengthwise. The company reports that in a couple hours when the weather is right, the hay is raked into windrows that give the air a chance to flow through the hay. When hay is ready for baling, bales go direct from baler to a trailing crop drying wagon. When the wagon is loaded, a portable dryer can be hooked up to it or to several wagons, and drying takes place under cover right on the wagon. A wagon holds 2½ tons of baled hay. One drier handles up to four of these wagons pulled up side by side or 10 tons of hay.

(For more facts circle No. 1 on reply card)

Plastic Fume Ducts and Hoods

The Ceilcote Co., Inc. has announced the development and availability of corrosion resistant plastic fume ducts and hoods. Fabricated of a thermo-setting plastic material which is combined with glass or other synthetic fibers, the new ducts and hoods can be produced to virtually any required shape.



The material used in construction offers chemical resistance, lightweight, strength, easy workability, design, flexibility and attractive appearance. Physical properties of materials used are said to range from 11,000 to 15,000 psi for tensile strength, and flexural strength ranges from 22,000 to 30,000 psi depending upon desired material thickness.

(For more facts circle No. 2 on reply card)

New Side Delivery Rake

New Idea Farm Equipment Co. has added the new No. 400 pull-type parallel bar rake to its line of rakes and tedders. The one-point hitch will fit all makes and models of tractors. The new rake is designed for high raking speeds up to 8 mph and has a full 8-ft raking width.

The rake may be purchased with 5.90-15 traction type tires or on rims only. Wheels are drop center disk type for use with any 15-in. tire up to 6.70-15. Rubber bushings are used at each end for the stabilizer and in lower end of suspension rods.

(For more facts circle No. 3 on reply card)

Offers Free Dairy Service

Babson Bros. Co., has developed a chemical water-testing service so that dairymen can match the detergent they use to the water on their farms and do a better job of cleaning equipment. The new service is

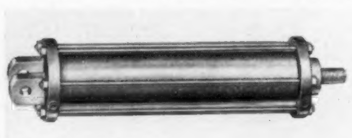
offered free of charge by Surge dealers in the interests of dairy sanitation.

After an on-the-farm test has been made, a formula card is tacked on the milk house wall. This card recommends the type and amount of detergent a dairyman should use based on hardness and iron content of his water.

(For more facts circle No. 4 on reply card)

Heavy Duty Air Cylinders

Densmore Engineering Co., Inc., has developed a new line of air cylinders designed and built to give long life under severe conditions and to facilitate maintenance on the equipment with simple tools. The capsule type gland of alloy steel has a long rod

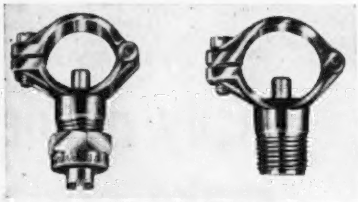


guide and independently adjustable V rod packing. Operating pressures are 150 psi on air and 500 psi in hydraulic service. Units are available in strokes up to 18 ft, from 3 through 8-in. bore with a wide choice of piston rod sizes.

(For more facts circle No. 5 on reply card)

New Type Spray Nozzle

Delavan Mfg. Co., has introduced a new agricultural eyelet nozzle, designed for quick, easy installation on any ¾-in. pipe or 1-in. tubing sprayer boom.



A feature of the new nozzle is its simplicity of installation. Once a hole has been drilled in the pipe, the nozzle can be clamped on. There is no need to slide other nozzles off the boom in order to get the new nozzle into place. The new eyelet nozzle has a large diameter inlet, which is said to minimize pressure drop even with large capacity nozzles.

(For more facts circle No. 6 on reply card)

New SP Combine

The Oliver Corp., has announced a new self-propelled Model 40 combine designed to save time, grain and machinery expense in all grain crops including corn.

A low-mounted cylinder provides straight-in feeding without a "break-over" in front of the cylinder. A corn header attachment

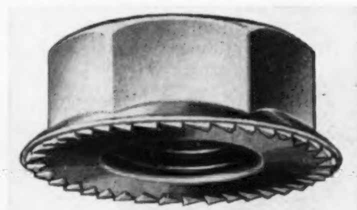
which operates without snapping rolls, is available.

Features of the new combine include a heavy-duty transmission, drive wheel tread adjustment from 92 to 128 in., variable-speed drive, 57-bu grain tank with one-minute unloading, folding grain-tank auger, new step-type straw walkers, double-disk brakes and optional power steering.

(For more facts circle No. 7 on reply card)

Spin-Lock Nuts

Russell, Burdsall & Ward Bolt and Nut Co., announces availability of spin-lock nuts designed to combine the function of nut and lock washer in one piece. Available in sizes ranging from number 8 to ½-in., the



new nut has a rachet-like structure on its base which is said to bite into the bearing surface of the metal to be joined, resisting tendency to loosen. Torque required to loosen the nut reportedly is greater than the tightening torque.

(For more facts circle No. 8 on reply card)

 For more facts circle No. 57 on reply card

New counterweight smothers vibration . . .

Heat-treatable ductile cast iron gives its thin sections high strength

In the new Ferguson "Dyna-Balance" Mower Drive*, the special properties of Ductile Cast Iron solve a difficult design problem.

Instead of the conventional pitman, Ferguson uses a Ductile Iron counterweight to balance the drive's double throw crankshaft and eliminate vibration.

High strength in thin sections with 60-45-10 Ductile

In this application, it is the heat-treatable Ductile Iron (60-45-10) that provides strength and toughness. The bosses are flame-hardened to give top wear resistance. The good castability of Ductile Iron makes possible engineering high strength in thin sections.

As Ferguson puts it:

"The use of Ductile Iron in this counterweight was the result of a need for high strength and moderately thin wall sections in a material suitable for heat-treatment. Ductile Iron could be cast in thin sections and provided sufficient strength. Ductile Iron counterweights, with flame-hardened bosses, have proved very satisfactory."

No other cast ferrous product offers such a useful combination of excellent castability and fluidity . . . high strength . . . wear resistance and machinability.

These may be just the properties you need to solve your design problem.

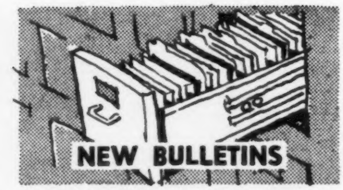
You'll find many practical ways to take advantage of Ductile Iron in the new Inco booklet: "DUCTILE IRON, The Cast Iron THAT CAN BE BENT." A copy is yours for the asking. Just write.

* * *

*Mower Drive built by Ferguson Division, Massey-Harris-Ferguson, Inc., Racine, Wisconsin

ductile iron . . . the cast iron that can be twisted and bent

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street, New York 5, N. Y.



Chemical Production Flow Sheets, Plant Diagrams, published by DECHEMA Deutsche Gesellschaft fur chemisches Apparatewesen, Frankfurt am Main 7, Postfach, Germany. Sells for DM 16, or DM 12.80 for members of DECHEMA, including postage and packing.

A set of 40 leaflets, size 210 mm x 297 mm, printed on one side, in duplicated typescript, and contains 220 diagrams representing the types of equipment which are most commonly used in chemical technology. These diagrams are said to enable the various stages of chemical processes to be represented by means of flow sheets which show the type of equipment which is employed and facilitates an exchange of views between chemists and engineers.

Farm Electrification Research, a report on special studies and research contributed to or conducted by electric operating companies from January, 1951, through December, 1955. Published by Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y. $1.25.

The 60-page report was compiled by the Institute's farm group and summarizes 222 research projects or special studies receiving support or sponsorship from electric companies. Work is being carried on to determine the effectiveness of electric applications in such varied fields as barn cleaners, calf pen heating, egg collection and cooling, fruit processing, greenhouse heating and ventilation, irrigation, pest control, plant propagation, poultry disposal, livestock feeders, crop processing, automatic smokehouse, tobacco curing and wiring.

Animal Sciences Film Catalog, 1957 edition, published by the Audio-Visual Center, State College of Washington, Pullman.

This catalog is a special film collection and is said to be a valuable information source for instructors, for extension workers, and for those who are interested in informational programs in the animal sciences fields. The distribution of films is restricted to the eleven western states, and the Center will fill requests for catalogs from groups and individuals in that area.

Pressure Treated Timber Poles, published by the American Wood Preservers Institute. Copies may be secured by writing the Agricultural Department, American Wood Preservers Institute, 111 W. Washington St., Chicago 2, Ill.

This 76-page booklet is illustrated and is said to contain case histories of long service life of poles; cost details; recommendations for pressure preservative treatment; design notes and typical layouts for pole-type buildings; pole specification and dimension tables of the American Standards Association; recommended pole sizes for sundry uses and depths of set for poles supporting buildings and poster structures.

The booklet is indexed for easy reference to subjects.

Lack of space will not permit a review of the following bulletins received recently. However, we would like to bring them to the attention of our readers.

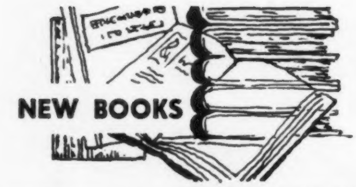
A Research-Designed Farm Home for all America, Late Fall Issue 7, 1956. *The Business of Farming,* United States Gypsum Co., tells the story of the University of Wisconsin's demonstration farm home and what it means to future farm living.

When You Remodel, a 4-page bulletin, September, 1956, put out by the Extension Service of the University of Wisconsin, Madison, shows plans of the remodeling of a demonstration home.

Mosquitos and Encephalitis in the Irrigated High Plains of Texas, by F. C. Harmston, G. R. Shultz, R. B. Eads, and G. C. Menzies, Vol. 71, No. 8, August 1956, from Public Health Reports, U. S. Department of Health, Education, and Welfare.

The following five articles are reprinted from the Quarterly Bulletin of the Michigan Agricultural Experiment Station, Michigan State University of Agriculture and Applied Science, East Lansing, for November 1956: *The Economics of Irrigating in Michigan,* by C. R. Hoglund, E. H. Kidder and K. A. Vary, Article 39-19; *Grain-Equivalent Value of Prebud Alfalfa Hay and Alfalfa-Rye-Grass Silage in Respect to Milk Production,* by C. F. Huffman, C. W. Duncan and R. M. Grimes, Article 39-22; *Gibberellic Acid and Higher Plants,* by M. J. Bukovac and S. H. Wittwer, Article 39-31; *A Theoretical Relationship of the Variables Affecting the Operation of Controlled Atmosphere Storage Rooms,* by I. J. Pflug and D. H. Dewey, Article 39-35; and *Solar Housing for Swine,* by J. S. Boyd and J. A. Hoefer, Article 39-36.

For more facts circle No. 76 on reply card



Tool Design (second edition), by Cyril Donaldson and George H. LeCain, Mechanical Department, Rochester Institute of Technology. Cloth, 6 x 9 inches, vii + 557 pages. Illustrated and indexed. Published by McGraw-Hill Book Co., New York, N. Y. $6.75.

This book was written as a textbook at the Rochester Institute of Technology for developing teaching materials which are practical in nature and closely related to the actual requirements of industry. It has been written especially for class study with questions, problems, drawing assignments, and references. However, the book should also be helpful for engineers whose work concerns tools, jigs and fixtures, gages, etc. Because of the treatment of the subject matter, together with the large number of worked-out samples, the book is an aid to the man who plans to study the subject of tool design at home.

Land Maschinen (Agricultural Machines) Vol. I and Vol. 2, by Dr. E. Schilling, Cologne, Germany. Vol. I *Agricultural Tractors*—illustrated and 440 pages. Vol. II *Tillage Implements*—Illustrated and 264 pages. Published by Dr. Schilling, Rodenkirchen, Koln, Germany.

These two volumes are valuable for the designer in the field of agricultural engineering as well as the student. They contain a selection of major theoretical equations and formulas for the design and performance of agricultural tractors and tillage implements.

Chapters in Vol. I include principle design, tractor mechanics, calculations and design for principle tractor components, test methods and research project, and hydraulics. Chapters in Vol. II describe soil mechanics, plows, disk harrows, rotary cultivators, drags, harrows, rollers, and cultivators.

Bearing Design and Application, by Donald F. Wilcock and E. Richard Booser. Cloth, 6 x 9 inches, xii + 464 pages, indexed and illustrated. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y. $12.50.

A practical guidebook for the machine designer in selecting and designing bearings, with emphasis on selection and calculation methods for integrating the bearing design, bearing material, and lubricant into a workable unit. Among the subjects covered are analysis of load capacity, speed, temperature, dimensional tolerance, and lubrication factors in selecting ball and roller bearings; combination of the latest digital computer analysis with bearing material and lubricant selection in hydro-dynamic journal and thrust bearings; reciprocating bearing design methods for automotive and diesel use; and lubrication system designs.

The authors have included equations for design procedures and frequent numerical examples. The book is said to provide the reader with a comprehensive picture of the factors entering bearing design and application problems in almost all types of industrial equipment, such as turbine, motor, automotive, appliance, and aircraft and military units.

Light, Vegetation and Chlorophyll, by J. Terrien, G. Truffaut and J. Carles. Cloth, 5 x 7 inches, 228 pages, illustrated and indexed. Translated from French by Madge E. Thompson. Published by the Philosophical Library, 15 East 40th St., New York 16, N. Y. $6.00.

This book has been translated from two works and is divided into two parts. The first section is concerned with the nature of light as a form of energy and the light-requirement of plants in different parts of the world and under different climatic conditions. The mechanism of the utilization of light by plants is discussed, and a comparison is made between the process of photochemistry in ordinary photography and photosynthesis. The degree to which the energy-needs of plants can be met by artificial light-sources is considered in relation to the improvement of crops and their production out of season.

The second part deals with the chemistry of chlorophyll and photosynthesis and should be of interest to those concerned in the production of high-protein foodstuffs. A summary of the importance of chlorophyll in the present-day world is included.

Farm Trouble, by Lauren Soth. Cloth, 5½ x 9 inches, vii + 212 pages, indexed and illustrated. Published by the Princeton University Press, Princeton, N. J. $3.75.

In this book the author takes a look at the problems of agriculture in a growing industrial economy. He discusses acreage controls, price supports, foreign trade, and the economic position of the farm families. In presenting these problems he sets forth his own proposals for policy changes and urges a "new look" at farm policy.

Now! Two big ways 1957 IH Tractors put power to better use!

NEW "TC" TRACTION-CONTROL FAST-HITCH / PLUS TA TORQUE AMPLIFIER

. . . gives you PULL-POWER second to none!

Say goodbye to frequent shallow-ups and shiftdowns! Here's your *double-barreled* answer to tough spots—new Fast-Hitch with Traction-Control, plus Torque Amplifier! See how this great combination of "grip and go" gives new McCormick® Farmall® 350, 450, and International® 350 Utility tractors pull-power out of all proportion to rated horsepower.

IH Traction-Control Fast-Hitch gives you continuous traction that *grows with the load!* This keeps you plowing full depth when others can't.

To give your IH tractor its second wind, just pull the Torque Amplifier lever. Instantly, without shifting, TA increases drawbar pull up to 45% to keep you plowing non-stop! This surging power-punch teamed with ground-gripping traction makes you master of the toughest plowing on your farm!

Call your IH dealer . . . he'll gladly demonstrate. Feel the "grip and go" of traction that grows with the load and the power-punch of TA. Try the new 4-plow Farmall 450 . . . 3-plow Farmall 350, or International 350 Utility.

See your INTERNATIONAL HARVESTER Dealer

International Harvester products pay for themselves in use—McCormick Farm Equipment, Farmall and International Tractors . . . Motor Trucks . . . Construction Equipment—General Office, Chicago 1, Illinois

Outplow them all with the "grip and go" of this new Farmall 450—pulling a new McCormick 4-furrow Fast-Hitch plow with individual spring trip beams.

For more facts circle No. 78 on reply card

MEMBERSHIP APPLICANTS

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Chartier, Yves—Agronomist, Farm Building Division, Department of Agriculture, Quebec, P.Q. Canada (Mail) 1005-C Birch Rd., East Lansing, Mich.

Clark, Everett M. — Advanced des. engr., International Harvester Co., Chicago, Ill. (Mail) 727 S. Loomis St., Naperville, Ill.

Dulin, William F. — Assoc. engr., Douglas Aircraft Co., Charlotte, N. C. (Mail) 1943 Woodcrest Ave.

Fuller, Dan C.—Application engr., Cummins Engine Co., Columbus, Ind. (Mail) 3017 Marr Rd., R.R. 1

Gribble, Donald V.—On duty with the U.S. Army (Mail) c/o A. W. Gribble, Port Orford, Ore.

Hall, Alfred D.—Irrigation officer, Department of Agriculture, P.O. Box 52, Ashburton. Canterbury, New Zealand.

Melendez, Julio A. — Chief of eng. div., Servicio Interamericano de Cooperacion Agricola en Panama, P.O. Box 1319, Panama, R. de P.

Milligan, Tom—Assoc. editor, Electricity-on-The-Farm Magazine, New York, N. Y. (Mail) 8848 Liptonshire Dr., Dallas 18, Texas

Moe, Richard G.—Engr., graduate training program. Allis-Chalmers Mfg. Co., Milwaukee, Wis. (Mail) R.R. 3, P.O. Box 55, Marysville, Calif.

Morton, Carl T. — Agr. engr., agr. eng. dept., Michigan State University, East Lansing

Neely, James A. — Agr. engr., Tennessee Valley Authority, P.O. Box 911, Jackson, Tenn.

New, Weston K.—Eng. trainee, Caterpillar Tractor Co., Peoria, Ill. (Mail) 1127 W. Garfield, Bartonville, Ill.

Schurr, James M.—Agr. engr., United States Bureau of Reclamation, Great Falls, Mont. (Mail) 620-3rd Ave., North, Great Falls, Mont.

Scott, Patrick F.—Experimental officer, East African Tractor and Implement Testing Unit, National Institute of Agricultural Engineering, Wrest Park, England (Mail) Box 22, Nakuru, Kenya

Sonomura, Mitsuo — Prof. of agricultural machinery, University of Osaka Pref., Agricultural Section Daisencho, Sakai City, Osaka Pref., Japan

Sutton, Claxton M. — Elecn. advisor, Tri-County Electric Membership Corp., Goldsboro, N. C. (Mail) P.O. Box 1321

Swenson, John T.—Engr., Caterpillar Tractor Co., Peoria, Ill. (Mail) 2003 W. Alice Ave.

Watson, Mark W. — Armco Steel Corp., Middletown, Ohio (Mail) 2317 S. 8 St., Terre Haute, Ind.

Williams, Charles A. — Engr.-in-training, Sylvania Electric Corp., Warren, Pa. (Mail) 17 Branch St.

(Continued on page 626)

. . . Applicants

(Continued from page 624)

Transfer of Membership

Adams, Charles B. — Sr. design engr., res. and dev. dept., New Holland Machine Co., New Holland, Pa. (Mail) 3 Kutz Ave. (Associate Member to Member)

Blaauw, Andrew—Product des. engr., Tractor and Implement Div., Ford Motor Co., Birmingham, Mich. (Mail) 3537 Linwood St., Royal Oak, Mich. (Associate Member to Member)

Campbell, Donald J. — Product des. engr., Tractor and Implement Div., Ford Motor Co., 2500 E. Maple, Birmingham, Mich. (Associate Member to Member)

Davis, Charles W. — Service supervisor, Florida Ford Tractor Co., P.O. Box 1258, Jacksonville, Fla. (Affiliate to Member)

Hansen, Ralph W. — Assist. prof. of agricultural engineering, Colorado State University, Fort Collins (Associate Member to Member)

Hore, F. Robert—Assist. prof. of agricultural engineering, Ontario Agricultural College, Guelph, Ontario, Canada (Associate Member to Member)

Jones, J. Nick Jr. — Agr. engr., (SWCRD, ARS), USDA, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) 503 Upland Rd. (Associate Member to Member)

Jutras, Pierre J.—Graduate res. assist., agri. eng. dept., University of Maine, Orono (Affiliate to Associate Member)

Kjelgaard, William L.—Assist. prof. of agr. eng., Pennsylvania State University, University Park (Associate Member to Member)

Smith, Robert M.—Product des. engr., Tractor and Implement Div., Ford Motor Co., Birmingham, Mich. (Mail) 903 Poplar Ave., Royal Oak, Mich. (Associate Member to Member)

Tobiassen, Arthur S.—Product des. engr., Tractor and Implement Div., Ford Motor Co., Birmingham, Mich. (Associate Member to Member)

Walker, Phelps — Agr. engr., (SWCRD, ARS), USDA, agr. eng. dept., Virginia Polytechnic Institute, Blacksburg (Mail) 118 Dunton Dr. (Associate Member to Member)

. . . News

(Continued from page 612)

National Council of ASAE Student Branch Officers

Members of the Student Branches of the American Society of Agricultural Engineers assembled at the Society's Golden Anniversary Meeting at East Lansing, Mich., in June, elected the following officers of the Council for the 1957-58 year:

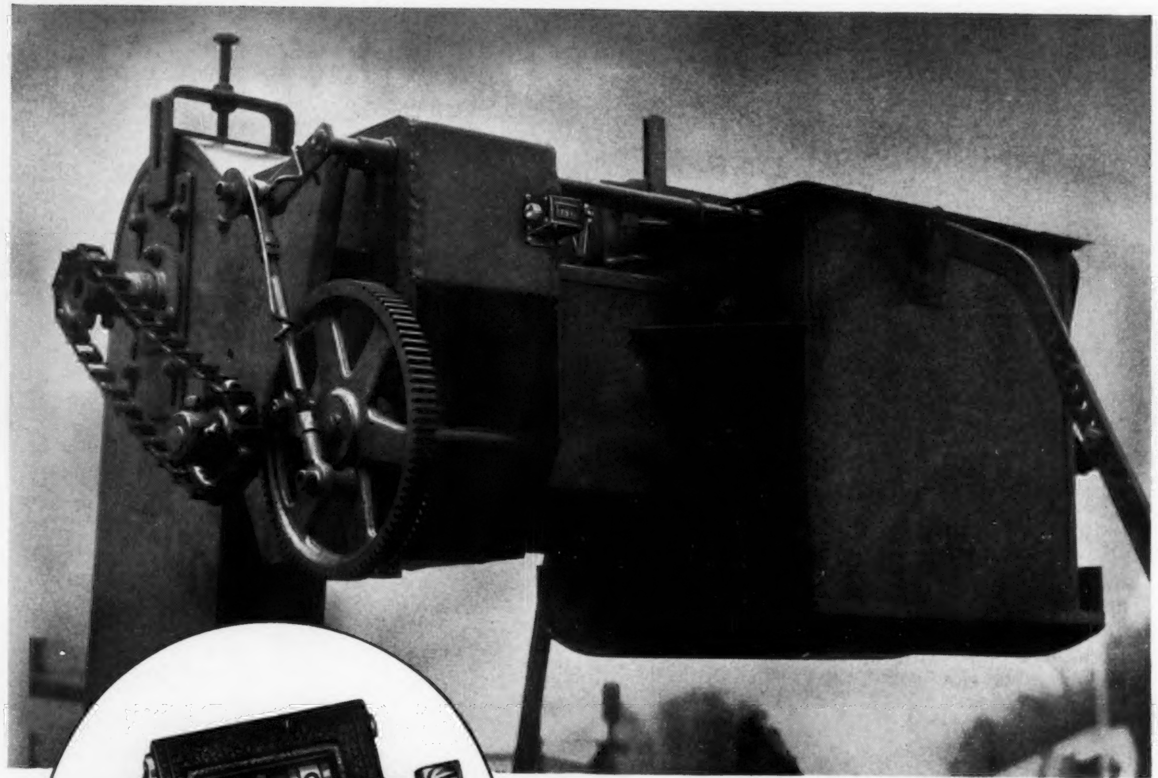
President — Kermit Allard, University of Maine

1st Vice-President—John Williams, Pennsylvania State University

2nd Vice-President — Glenn Drummond, Alabama Polytechnic Institute

Secretary — Herschel H. Klueter, University of Illinois

These officers were installed following their election on June 26.



Combine Owners: Here's how a built-in

VEEDER-ROOT COUNTER

helps you 4 ways!

1. **IN CUSTOM COMBINING.** Counts every bushel right in the field.
2. **IN SHARING THE HARVEST.** The accurate tally tells the yield exactly, prevents arguments between landlord and tenant.
3. **IN FARM STORAGE.** Permits storing or dividing grain in the correct amounts.
4. **IN YIELD VERIFICATION.** Helps check the use of fertilizer or the advantages of summer fallow.

For accurate counting (and cost-controlling) down on the farm, Veeder-Root makes a complete line of counters which are built into tractors, hay balers, grain drills and combines. *Get the facts* whether you make, sell, buy or use farm equipment. Write for bulletin.

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If you are not a member of the American Society of Agricultural Engineers and want (1) to subscribe* to AGRICULTURAL ENGINEERING or (2) to receive information about ASAE membership—or if you *are* a member of ASAE and want to propose the names of one or more prospective members — then simply fill out and mail the card at the right.

(*NOTE: A subscription to AGRICULTURAL ENGINEERING is included in the annual dues of each ASAE member.)

CHECK

☐ I want to receive AGRICULTURAL ENGINEERING regularly. Enter my subscription for one year ($5.00 in USA; $5.50 in Canada; $6.00 elsewhere). Payment is enclosed.

☐ I would like information about membership in the American Society of Agricultural Engineers, including an application form. (I understand that a subscription to AGRICULTURAL ENGINEERING and a copy of AGRICULTURAL ENGINEERS YEARBOOK are included in the annual dues of ASAE members.)

☐ I am an ASAE member and suggest that membership information, including application form, be sent to the name and address below. I can supply names of ______ more prospective members. My name is ______

Name ______

Position or title ______

Address (☐ Home or ☐ Business) ______

City ______ **Zone** ______ **State** ______

Employed by ______

Use the card *below* for free data on new products and the card *above* for subscribing to AGRICULTURAL ENGINEERING, or for requesting information about membership in the ASAE.

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AUGUST 1957

→ ***Please print or type your name, etc., below*** ←

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Name of employer ______

Address of employer ______

City ______ Zone ______ State ______

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4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
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Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the right and drop it in the mail today.

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Do you want more data or other information on products or catalogs advertised or otherwise featured in this issue? Then fill out one of the two mailing cards at the left and drop it in the mail today.

Our "Reader Information Service" clerks will see that your wants are promptly transmitted to sources of materials requested.

Kindly have mailed to me, without obligation, more information about items in this issue indicated by the numbers circled below: **AUGUST 1957**

Please print or type your name, etc., below

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Your position or title ____________

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New Products, New Catalogs, and Advertisements in AGRICULTURAL ENGINEERING

1	11	21	31	41	51	61	71	81	91
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MANUFACTURERS' LITERATURE

Milking Machine Regulator

Babson Brothers Co. — This 4-page brochure describes and illustrates their milking machine regulator that holds the vacuum at the proper milking level. It can be used for pipe lines and bucket milker installations.

(For more facts circle No. 9 on reply card)

Flat Nut Fasteners

Prestole Corporation — Data on length, width, material thickness, screw size, and other information on flat nut fasteners is included in a 4-page pamphlet. Flat nut fasteners designed with or without welding nubbins and with rivet holes, for various attaching methods, are listed and illustrated in detail.

(For more facts circle No. 10 on reply card)

Instant Screen Change Hammermill

Schutte Pulverizer Co., Inc.—A one-page bulletin describing the company's latest addition to its line of heavy-duty instant screen change hammermills, the Model No. 68 with 20-in feed opening and 75-100 hp range. A specification chart is included.

(For more facts circle No. 11 on reply card)

Large-Size Nuts

Security Locknut Corp. — This 4-page booklet illustrates and describes the various types of nuts manufactured by the company. The line includes large, standard, jam, slotted and lock nuts. Specification charts for nuts over 2 inches are included.

(For more facts circle No. 12 on reply card)

Roller Chains and Sprockets

Diamond Chain Co., Inc. — A 68-page catalog No. 757, describing and illustrating the company's line of stock roller chains and sprockets. Data is included on how to select a stock roller chain drive, establishing service horsepower required, and determining size of driven sprocket.

(For more facts circle No. 13 on reply card)

Soil Fumigant

Carbide and Carbon Chemicals Co. — A folder, F-40220, explaining the use of a new, powdered soil fumigant called Mylone that needs no plastic cover. It acts as a herbicide, soil fungicide, and nematocide in preplanting treatments on a variety of ornamentals.

(For more facts circle No. 14 on reply card)

Pipe and Tubing

Trent Tube Co. (Subsidiary of Crucible Steel Co. of America) — This 48-page manual for engineers, purchasing agents, and users of stainless steel and high alloy pipe and tubing describes the company's tubing which ranges in size from ⅛ to 40 in. in outside diameter.

(For more facts circle No. 15 on reply card)

Power to Farm at Lower Cost

Allis-Chalmers Mfg. Co. — A 16-page booklet called "Give Yourself the Power to Farm at Lower Cost" (TL-1647). It reviews the company's line of farm equipment.

(For more facts circle No. 17 on reply card)

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. . . Section News

(Continued from page 614)

Michigan Section

The Michigan Section meeting was held April 24 at the C. S. Howell Boy Scout Camp at Brighton, Mich. One hundred and twenty-five members, wives and guests attended the evening meeting. The national president of ASAE, Roy Bainer, was the speaker. He told about the research activities at the University of California on electronic lemon sorting, grape harvesting, internal combustion nut cracker and summer cooling of cattle and hogs. Square dancing was enjoyed by all immediately following the meeting.

The officers for the next year are as follows: Chairman, Nolan Mitchell; vice-chairmen, Tunis F. Rice, Donald P. Brown, and James P. Carr; secretary and treasurer, Fred H. Buelow.

West Virginia Section

The West Virginia Section met in the forestry building on the West Virginia University Campus, May 17, with Chairman J. L. Darby presiding.

The speaker was A. D. Longhouse, head, agricultural engineering dept., who discussed the proposed new buildings for the College of Engineering and College of Agriculture, Forestry and Home Economics at West Virginia University. Plans for the agricultural engineering building were also explained.

The following officers were elected for the coming year: H. M. Rhodes, chairman; R. A. Phillips, vice-chairman; and J. L. Copeman, secretary.

Florida Section

A meeting of the Florida Section was held April 26-27 in the Florida Citrus Mutual Building, Lakeland, Fla. The program opened Friday afternoon with an address by the Section chairman, Walter J. Eichelberger, followed by papers presented on the importance of phosphate to agriculture, by Harry M. Feigin; and Florida's important new industries, by Milton D. Blanck. A tour of Food Machinery and Chemical Corp. in Lakeland was scheduled. The annual Section dinner was held Friday evening with Rush E. Choate speaking on agricultural engineering, a mature profession — our obligations.

A short business meeting was held after the dinner and the following officers were elected for the coming year: Chairman, Ralph C. Lambert; vice-chairmen, Soloman J. Folks, Jr., Benjamin E. Wiggins, and Dalton S. Harrison; secretary, Saint Elmo Dowling; and treasurer, J. B. Richardson.

Saturday morning, April 27, James C. Morton and George Young spoke, respectively, on citrus mechanization, and mechanization in the cattle industry. A tour of Shirriff - Horsey Corp., Ltd., concentrate plant in Plant City, closed the meeting.

Minnesota Section

The Minnesota Section meeting was held April 25 on the St. Paul campus of the University of Minnesota. There were 62 in attendance for the afternoon session and 72 for the dinner. The program subject was on handling the forage crop and panel discussions were presented on hay vs. grass silage in the dairy ration, making and preserving grass silage, and machinery problems and developments in forage harvesting. A laboratory open house was held followed by the annual dinner. Roy Bainer, president of ASAE, was the dinner speaker and he discussed trends in mechanical agriculture.

The following officers were elected for the coming year: Chairman, C. L. Larson; vice-chairman, Wallace Shelley; and secretary-treasurer, Ardell Larsen.

Oklahoma Section

The Oklahoma Section meeting was held April 26 in Anadarko, Oklahoma. The morning was spent as guests of the Western Farmers' Electric Cooperative. The general manager of the cooperative, E. E. Karns, welcomed the group and Ancel Simpson, assistant manager, discussed the history and growth of rural electric cooperatives up to the present time and the events leading to the formation of the Western Farmers' Electric Cooperative. This cooperative serves a group of eleven retail cooperatives in western Oklahoma. A tour of the cooperative's steam generating plant followed.

Lunch was followed by an illustrated lecture by L. L. Males. His talk showed the advantages of the upstream prevention of floods as done by the USDA. Harry Pitzer, vice-president of the Public Service Co., discussed the progress of the company from 1907 to the present. The last part of the meeting was spent in touring the outdoor 230,000-hp steam generating plant at Washita, Okla.

Colonel Harold E. Bisbort, Mobile District Engineer, Corps of Engineers, U.S. Army, reported on the development of Alabama's water resources during the Alabama Section meeting held April 11 and 12. Interested onlookers are *(left to right)* M. L. Nichols; Lawrence Ennis, Jr., section chairman, and William T. Cox, section secretary. An account of the meeting appeared in the May issue.

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Farmers have suggested some of the features contained in these new NEW IDEA pickers. These suggestions, along with continued engineering improvements, permit corn farmers to say—year after year—"NEW IDEA picks cleanest, husks cleanest, gets more down corn."

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Following are brief reviews of papers presented at ASAE meetings or other agricultural engineering papers of which complete copies are available. Information concerning copies of these papers may be obtained by writing to the American Society of Agricultural Engineers, St. Joseph, Michigan.

A Comparison of Sprinkler Size and Spacing on the Uniformity of Water Distribution, by John McCavitt, irrigation engineer, Rainy Sprinkler Sales, Peoria, Ill. Presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a program arranged by the Soil and Water Division. Paper No. **57-94.**

The author points out that often in the design of sprinkler irrigation systems, insufficient thought is given to the proper spacing of sprinklers. He states that the selected spacing affects the application rate and plays an important part in the determination of the uniformity of application of the water. In designing sprinkler irrigation systems, the desired application rate, as well as a required high degree of uniformity of coverage should be considered. Group tests have been conducted to determine the degree of uniformity when using various model sprinklers at different spacings and with numerous nozzle combinations operating at various pressures. Charts are included showing results of these tests.

Streambank Protection, by Donald A. Parsons, ARS, USDA, East Aurora, N. Y. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a special program arranged by the Soil and Water Division for Public Lands and Public Works. Paper No. **PL-28.**

Observations of stream behavior and streambank protection are described in this paper. Aside from the obvious fact of the tendency of streams to erode the outside banks of bends, the most important, pertinent to streambank protection measures, is the down-valley migration of the meander pattern, described by C. R. Allen in 1895.

The author states that much has been learned since then that helps in the general understanding of the problem, yet we are still unable to satisfactorily predict the requisite strength of revetment for bank stabilization. Needed are detailed observations for typical geometrical situations and stream flows, upon which the designs for bank protection can be based. Observed locations of bank areas in bends under major attack are shown in the paper.

Low Cost Cooling of Livestock Shelters Using Galvanized Steel, by Leland E. Bradley, field manager, American Zinc Institute, Lafayette, Ind. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a program arranged by the Farm Structures Division. Paper No. **57-75.**

Excessive temperatures in poultry houses in the South have received much attention recently. This paper discusses an investigation which was undertaken to find a low-cost white coating which would reflect the heat and be practical for the average poultryman. Several mixtures proved successful, one of them costing less than 5 cents per 100 sq ft for material. It was reported that the temperatures beneath the white coated galvanized roof at no time became high enough to reduce feed consumption or cause mortality. There were losses in untreated houses.

The author explains that the reflective roof is not the complete answer to the poultryman's problems. Papers were placed beneath another roof, leaving a 4-in air space between, which reduced condensation, and seemed to show promise. Asphalt impregnated insulation board placed directly beneath galvanized roofing keeps out radiant heat and prevents moisture condensation, and is being used in some new construction.

Farm Drainage Pumping in Michigan, by Robert A. Sanderson and Karl R. Klingelhofer, area engineers, SCS, USDA, Saginaw and Kalamazoo, Mich., respectively. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a program arranged by the Soil and Water Division. Paper No. **57-85.**

Approximately 45,000 acres of Michigan farm land have been made usable through pump drainage, according to this paper. An estimated 400 farm pumping plants now are in operation in the state, the authors report. Acreages involved range from 10 acres to 8,000, with an average of approximately 80 acres per installation. Many of the more recent installations are fully automatic and have been installed with SCS technical assistance. The majority of these pumping plants are privately owned and service individual farms. These plants lift the drainage water, either tile water or surface water, to an elevation from which it will flow away from the farm by gravity.

The authors base their paper on records of the SCS work in Michigan and other available sources. They trace the history of farm pumping to its present development, discuss areas adaptable to pump drainage, types of pumps used and costs involved. The work is illustrated with pictures of various installations.

Range and Grassland Surveys, by Fred G. Renner, SCS, USDA, Washington, D.C. Paper presented at the Golden Anniversary Meeting of ASAE in East Lansing, Mich., June, 1957, on a special Soil and Water Program for Public Lands and Public Works. Paper No. **PL-34.**

Range and grassland surveys were first undertaken by the federal government about sixty years ago. These surveys covered rather broad regions and helped to acquaint the general public with the importance of the grazing resources of these lands, as well as with some of the problems involved with their management.

Later, a more formalized and detailed system of range surveys was developed which was eventually adopted as standard by all federal agencies concerned with both public and private grazing lands. The method for determining the grazing capacity of range areas which was an essential feature of the survey procedures proved unreliable, however, and led to a search for improved survey techniques. The range site and condition surveys developed by technicians of the Soil Conservation Service are now widely used by other agencies. These surveys provide basic information on the capability of different areas of range lands as well as on their present condition in relation to their potential. The methods for making range site and condition surveys are explained and their uses discussed.

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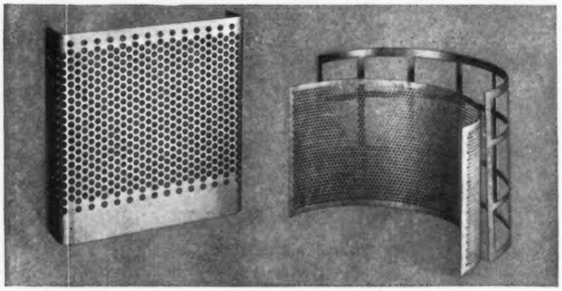

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Research in the United States and Other Countries

• By John R. Davis

The 87-page report contains information on individual evaporation and evapo-transpiration research projects including number and title of project, cooperating departments and agencies, project personnel, project description, status of project, results and publications. Data was obtained from nearly every state and federal agency in the United States and some foreign countries.

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PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listings.

POSITIONS OPEN — JANUARY — O-8-701. FEBRUARY—O-14-702, 14-703, 23-704, 23-705, 23-706, 12-707, 28-708, 38-709. MARCH—O-21-710, 52-711, 60-712, 45-713, 45-714, 81-715, 84-716, 70-717. APRIL—O-90-718. MAY—O-141-719, 141-720, 154-721, 154-722, 155-723, 164-724, 165-725, 99-727. JUNE—O-179-728, 189-729, 170-730, JULY—O-231-732, 237-733.

POSITIONS WANTED — FEBRUARY—W-13-1, 33-2, 10-3. MARCH—W-61-4. APRIL—W-68-5, 74-6. MAY—W-51-7, 96-8, 128-9, 159-10. JUNE—W-186-11, 171-12, 180-13, 190-14. JULY—W-193-15, 192-16, 238-17.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER for project engineering on farm machinery, including design, drafting, test, shop and field liaison, specifications, and allied work, under direction of chief engineer, with manufacturer in north central area. Age 25-35. BS degree in agricultural or mechanical engineering. Three or more years experience in similar work. Aggressive, with initiative and ability to work with people; potential for leadership and advancement. Good opportunity for advancement. Salary open. O-183-734

AGRICULTURAL ENGINEER for design work on agricultural machinery, especially cotton tillage and harvesting equipment, with manufacturer in south central area. Age, under 35. BS degree agricultural or mechanical engineering. Farm background required. One or two years engineering experience desirable but not required. Usual personal qualifications for design engineering. Average opportunity for advancement. Excellent experience in a variety of engineering activities. Salary open. O-196-735

AGRICULTURAL ENGINEER, assistant or associate professor rating, for research in power and machinery in agricultural experiment station. Some teaching in a farm power course. Pacific island location. MS degree in agricultural engineering, or equivalent. Farm background and some previous design and teaching experience desirable. Usual personal qualifications for college research and teaching. Normal opportunity for advancement in a growing department. Usual vacation and sabbatical provisions. Yearly automatic and merit raises. Salary $6,000, minimum starting. O-248-736

AGRICULTURAL ENGINEER, assistant professor rating, for research in power and machinery in an eastern land grant university. Present work is in harvesting equipment. Opportunity for additional work on crop handling and on irrigation. BS and MSAE or BS in both agriculture and engineering, with above-average scholarship. Will consider 1957 MSAE. Farm background. Appointment on 12-month basis. Salary open. O-255-737

SPECIAL PRODUCTS ENGINEER to head department specializing in irrigation and crop drying equipment in distributor organization. Eastern location and territory. Age, over 25. BSAE and preferably some experience in irrigation and crop drying work. Free to travel. Pilot's license desirable. Good opportunity for advancement. Salary open. O-259-738

AGRICULTURAL ENGINEER, professor or associate professor of extension in food processing with eastern land grant university. Work with processors and marketing firms on engineering problems related to handling, storage, refrigeration, packaging, quality control, etc. Age 30-40. MSAE or MS in food engineering. Several years of responsible experience related to food engineering. Able to cooperate with and command the personal and professional respect of high level professional individuals in the food processing industry. Salary $6812 to $9826, depending on qualifications. O-265-739

AGRICULTURAL ENGINEER, associate or assistant professor, for teaching, research, and extension in farm structures, with an eastern land grant university. Age 26-40. MSAE. Several years experience in teaching and/or research in farm structures. Able to cooperate. Interest in and ability to work with and advise junior staff members and graduate students. Imagination in developing research program. Good opportunity for advancement. Salary $5889 to $8684, depending on qualifications. O-265-740

NEW POSITIONS WANTED

MECHANICAL ENGINEER for development, research, sales, service, or management in power and machinery with manufacturer or consultant, preferably in warm climate area. Married. BSME in 1946. Experience over 11 years on engines and related equipment in industry and Air Force, in US and other countries, including setting up bases for work shops and service centers. Available on short notice. Salary $8,000. W-206-18

AGRICULTURAL ENGINEER for development, research or teaching in power and machinery with public service or manufacturer, preferably in Midwest. Married. No disability. BSA, 1953; BSAE, 1957; MSAE expected in August, Ohio State University. Research assistant in experiment station 2 years; aircraft maintenance officer in USAF, 2 years. Available Sept. 1. Salary open. W-246-19

AGRICULTURAL ENGINEER for design, development or research in power and machinery, with manufacturer or farming operation anywhere in USA. Single. Age 24. No disability. BA in mathematics and physics, 1950 and BSME, 1953, Pakistan. MSAE, 1957, Oregon State College. Available now. Salary open. W-247-20

AGRICULTURAL ENGINEER for extension, teaching or management in power and machinery or soil and water with federal agency, manufacturer, processor, distributor or consultant. USA or foreign location with adequate living and educational facilities for family. Married. Age 39. No disability. BSA, 1952, University of Florida. Farm background. Experience as district sales manager for specialized line of farm equipment, and as assistant director and director of agriculture for Government of American Samoa. Available on 30 days notice. Salary $8,000-10,000. W-216-21

AGRICULTURAL ENGINEER for teaching, sales, or service in soil and water field with public service, distributor or trade association, preferably in South or Southeast. Willing to travel. Married. Age 31. No disability. BSAE, 1950, Louisiana State University. Farm background. Experience since graduation as grocery clerk, head of produce department, in a chain store. War enlisted service in Navy, over 2 years. Available Sept. 1. Salary $4,000. W-254-22

AGRICULTURAL ENGINEER for development, teaching, or research in soil and water field with industry or public service, anywhere in USA. Married. Age 31. No disability. BSAE, 1949, University of Nebraska. MSAE, 1956, Kansas State College. PhD, major in irrigation engineering expected June 1958, Colorado State University. Farm background. Partner in farm 3 years. Graduate teaching and research assistant 3 years. Enlisted and commissioned service, mostly as weather officer in USAF. Available June 1958. Salary open. W-239-23

AGRICULTURAL ENGINEER for extension, teaching, or research in farm structures or rural electric field, with public service agency in East or South. Limited travel. Married. No disability. BSAE, 1952, Virginia Polytechnic Institute. Farm background. Experience with electric utilities 5 years. Enlisted service, USAF, 1½ years. Available on 60 days notice. Salary $6,000. W-242-24

AGRICULTURAL ENGINEER for sales, service, or farm management in power and machinery, soil and water, or public works, with manufacturer or farming operation in Southwest or West. Married. Age 31. No disability. BSAE, 1951, Louisiana State University. Farm background. Precollege work as mechanic. Work with FHA and SCS. Experienced in planning, design, and installation of conservation measures, including drainage, land leveling, and all types of irrigation. Service in US Navy 2½ years. Available on reasonable notice. Salary $4,800. W-256-25

AGRICULTURAL ENGINEER for sales work in power and machinery field, with manufacturer in Midwest. Married. Age 37. No disability. BSAE, 1948, University of Illinois. Territory supervisor for major farm equipment manufacturer 6 years. Sales engineering in related lines 3 years. War enlisted and commissioned service in Air Force 6½ years. Available on 30 to 90 days notice. Salary $6,000 min. W-261-26

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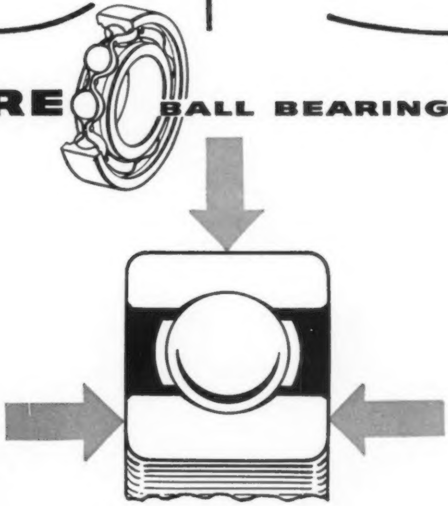

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